POWER

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Unemployment

WE HAVE HEARD a great deal of late about unemployment, its causes and "implications," its "correlations" and consequences.

But nobody seems to know what to do about it.

There is a lot of commendable activity for the satisfaction of immediate needs and the relieving of present distress, but, so far as I know, there has been no systematic analysis of the fundamentals and study of permanently corrective processes.

How many man-hours of work are necessary to feed and clothe and shelter and educate and amuse and protect and minister to the cultural needs of the population?

How much man-power is available to do this work?

How many hours per day can each productive worker (outside of the executive and professional classes) be kept busy when the needs of all are provided for?

Should the limitations of the working time of each be set by the adoption of a shorter working day or week or by earlier retirement?

How does the equipment of the various industries conform in extent and efficiency to a stabilized demand for their product?

What is the aggregate income of the nation and how is it divided as between production, administration, overhead, investment, promotion, distribution and manipulation?

What is the minimum wage upon which a family should be expected to live under approvable conditions.

How can the ability of those of the lower stratum to exchange their services for a respectable livelihood be assured without increasing the cost of production, and thus the purchasing power of their and other wages so much as to neutralize the increase?

What is the actual cost of production of the essentials of life and how much spread is there between this cost and the price to the consumer? With all of our improved facilities is there any physical reason for the constantly increasing cost of living?

We are rich in natural resources and in accumulated wealth. There is a certain amount of necessary work to be done in order that all may live in comfort and plenty. We ought to have executive ability enough to devise an industrial and financial model upon which our abundant man-power could be set at work doing it and get a sufficient proportion of their product to satisfy their needs and keep the machine in motion.

F. R. Low

EDITORIALS

Smoke Elimination And Public Policy

EVIDENCE of awakening public consciousness to the smoke and flue dust evils is growing. On all sides there are signs of interest, and in some places the public is entering the courts with evident intention to better the condition of the atmosphere it breathes.

The usual plan has been for cities to administer their smoke laws through municipally appointed smoke commissioners who are trained engineers. But some are attempting the solution through their health departments, with medical men in charge.

With due respect to the medical profession, the doctors are out of their element in smoke abatement work. To be sure, the public health is involved, but the cure is strictly an engineering problem that requires not the stethoscope but the Ringleman Chart, reinforced with a fundamental knowledge of combustion and plenty of experience.

Smoke commissioners with engineering experience recognize that the most flagrant offenders are among the domestic and small industrial fuel burners who are ignorant of the first principles of combustion. Nevertheless, the public utility companies, although certainly not in these groups, constitute the big class of potential mass producers of smoke, cinders and fly ash. So they must expect to be among the first to receive attention.

Many of the utilities have spent large sums in research, experiment and actual equipment to eliminate their stack nuisances.

If they will all make their work known, their efforts should not only receive a healthy appreciation from the public, but greatly inspire those who have as yet done nothing.

Where such communities as the Commonwealth of Massachusetts enact legislation for smoke abatement such as will actively go into effect January first, others may be expected to follow.

Under such circumstances the time seems to have arrived for a policy of open treatment of the whole subject by all who are interested.

High Concentrations In River Waters

AS A RESULT of the extended drought during the late summer and fall the quality of water in many tidal rivers in the East has been greatly depreciated. This has been due to the lack of fresh diluting water entering the surface streams, thereby causing considerable concentration of organic and inorganic solids. The condition has been further aggravated by the backing up of sea water. Considerable hardship to users of such water for industrial purposes has resulted.

This situation has been marked in the tidal section of the Delaware River, and the salt content of the river below Philadelphia has increased manyfold. One company has reported an increase in the salt content of the river at its intakes from twenty parts per million to five hundred parts per million; the salt a few miles below Philadelphia has risen to as much as one thousand parts per million. In many cases a marked reduction in the efficiency of water-softening equipment has been noticed and more frequent blowing down of boilers has been found necessary. Excessive carryover of solids to the turbines has resulted in some cases. Failure to thoroughly recognize this condition may result in serious operating troubles.

Chemical Cycle Opens New Vistas

THIS is distinctly a pioneer age in the field of power. When the inclination is to believe that the limits of progress are in sight, the scene has a way of shifting to reveal new horizons.

For years advanced power thinkers have been seeking to realize Sadi Carnot's ideal of a generating cycle receiving heat at the highest possible temperature level and rejecting it at the lowest. Even with high steam pressures, the present-day steam plant falls short of this idea, by supplying most of the heat at the relatively low temperature level of saturated steam at boiler pressure.

The only apparent alternative has been to use for the upper ranges some fluid that evaporates like water, but produces a moderate saturation pressure at the highest temperature permitted by boiler metal. To date the mercury-steam cycle is the nearest approach to this requirement. The Hartford installation, with a net consumption lower than 10,000 B.t.u. per kilowatt-hour, is the remarkable result of its intelligent utilization. This approach to higher efficiencies is sound.

It must not be imagined, however, that simple evaporation at high saturation temperature is the only solution. Dr. Ing. F. Koenemann, of Germany, has made clear the possibilities of a binary-vapor cycle utilizing the heat of chemical combinations. Alchemy itself could be no more strange to orthodox power thinking than his proposal (*Power,* October 28) to produce highly superheated vapor without any superheating process. Ammonia vapor, produced by heating zinc-chloride ammoniacates, is superheated at the moment of its formation. To put it another way, the vapor arrives at the top of the temperature entropy diagram without the labor of climbing there.

It should not be inferred that the Koenemann cycle will surpass the mercury-steam cycle in efficiency. In fact, Doctor Koenemann admits a slightly lower efficiency, but claims certain other advantages, chief of which is that the zinc-chloride ammoniacates he recommends are cheap and available in unlimited quantities.

It is too early to say definitely that the practical problems involved in the handling of ammonia vapor and compounds at high temperatures will easily be solved, but the proposal is distinctly promising. In addition, the field is opened for possible use of innumerable other compounds from which superheated vapor can be produced by the application of heat.

Practical development of the Koenemann cycle will permit modernizing old steam plants by adding an ammonia "top," just as high-pressure steam plants have been superimposed on low. Steam produced by the exhaust heat of the ammonia turbine may be utilized in existing systems.

Thus we have another source of cheaper power, and at the same time a new demonstration, if any were needed, that nothing is static in the field of power.

The Source of Elevator Accidents

AFTER five years' study the Elevator Safety Code Committee of the American Standards Association has made its report. An interesting and important fact brought out is that ninety per cent of all elevator accidents are attributable to lack of proper interlocking devices between car movement and the position of hoistway and car doors. The report further points out that over seventy-five per cent of these accidents can be definitely assigned to the operators' or passengers' carelessness.

Here is statistical proof of a long-recognized fact. Nevertheless, few states have laws requiring the use of such interlocks. Without these devices, the operator is free to move the car with the doors in any position. With no control over the movement of passengers, a condition thus exists that holds infinite possibilities for accidents.

In states where interlocking devices on hoistway and car doors are mandatory, serious accidents to passengers are practically unknown. It is only when these devices are made inoperative that such accidents can occur.

High car speeds are frequently stressed as a serious hazard, when, in fact, modern high-speed, push-button-controlled elevators are the safest.

Regardless of how the elevator-accident problem may be considered, it points to one solution, namely, interlocks on the hoistway and car doors so that they must be closed before the car can be started.

Automatic Power Plants

THE OWNER of a small factory is on the horns of a dilemma when he approaches his power problems, and whichever horn he grasps, he usually loses.

If he installs his own plant, the item of operating labor will make his unit generating costs high. If, to avoid this, he decides to purchase energy, he is penalized, compared with his larger competitor, since electrical rates usually favor the large consumer.

A reasonable query is—why have the labor item at all?

Control systems have now been perfected whereby mechanical or electrical instruments carry on many functions that formerly required personal attention. Already in the power field hydro plants are being controlled automatically.

There is no reason why a steam plant of small capacity cannot be automatic to the extent of requiring no attention other than a daily inspection.

The oil engine, likewise, is adaptable to automatic operation. Load changes can be handled by the stopping or starting of additional units, and water, fuel or lubricating oil trouble on one engine would cause it to be shut down and another started up.

POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

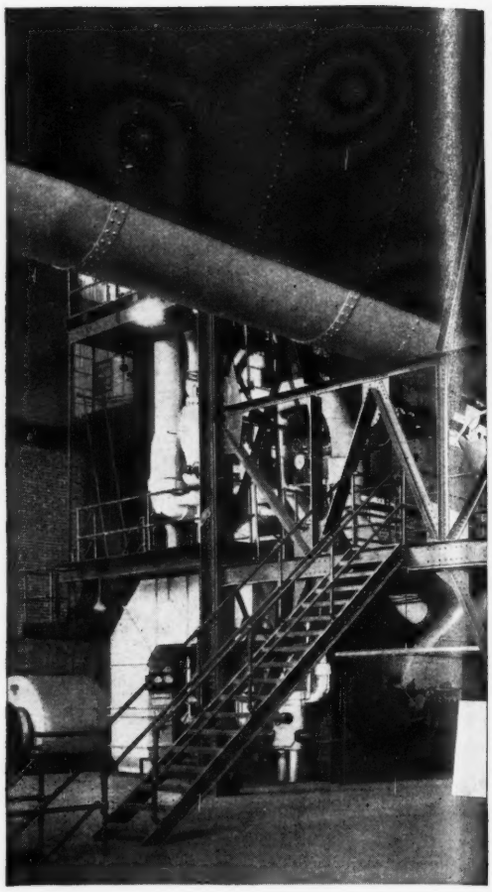


Fig. 1—Burners in side walls of high-pressure boilers

Burning GAS at Memphis Power & Light Plant

By R. BRUCE
Superintendent of Power
Memphis Power & Light Company

WHEN AN operating organization is faced with the necessity of changing from an old, well-established fuel, such as bituminous coal, to one of radically different physical characteristics, like natural gas, it is, of course, somewhat apprehensive as to just what will happen in the first weeks of operation. Such was the situation at the Fourth Street station of the Memphis Power & Light Company, when, in the fall of 1928, it was decided to convert the furnaces to natural-gas burning.

The boiler plant consists of two sections, the old low-pressure and the new high-pressure. Both sections are, however, under one roof, with no intervening walls. The firing aisles are on the same center line, one being an extension of the other.

The old, or low-pressure, section consists of eight 6,000-sq.ft., 200 lb. working pressure, longitudinal-drum, inclined-header Babcock & Wilcox water-tube boilers, four on each side of a central firing aisle and originally served by chain-grate stokers equipped with flat, suspended arches. Draft for these boilers is created by two concrete chimneys 230 ft. high with 15 ft. inside diameters at the top. These stacks also supply draft for the high-pressure boilers. All the low-pressure boilers deliver steam superheated about 100 deg. F. and are equipped with U-bend overdeck superheaters.

The new, or high-pressure, section consists of four 15,120-sq.ft., cross-drum, vertical-header Babcock & Wilcox boilers operating at 340 lb. gage. Before conversion to natural gas these were served by multiple-retort underfeed stokers, three of which were equipped with steam ash dumps and one with a clinker grinder. Superheaters of the U-bend, interdeck type, placed six rows of water tubes above the furnace, superheated the steam approximately 220 deg. F. when burning coal. The furnace volumes, above tuyères, were approximately 3,600 cu.ft. for each boiler, or 4.2 sq.ft. heating surface per cubic foot furnace volume.

The West Kentucky No. 9 seam pea and slack coal used, for the most part, gave an average proximate analysis as follows:

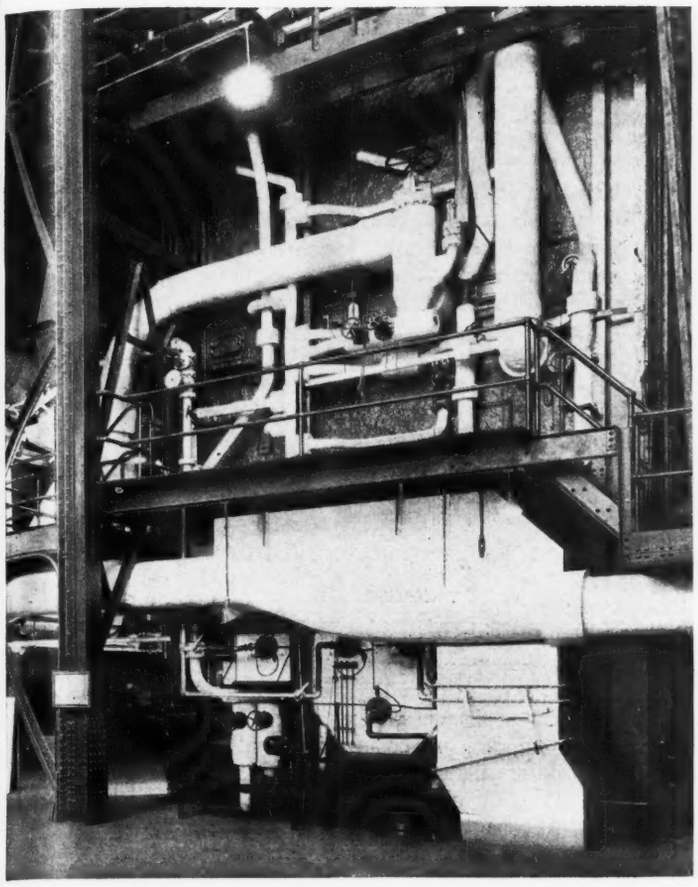
	As Received
Moisture, per cent	10.3
Ash, per cent	12.0
Volatile matter, per cent	34.7
Fixed carbon, per cent	43.0
B.t.u. (bomb calorimeter)	11,250
Sulphur, per cent	4.1
Fusing point of ash, deg. F.	1,875–1,950
Fluid point of ash, deg. F.	1,915–2,040

When firing this coal a great deal of refractory erosion was occasioned by fly ash striking the incandescent brickwork, fusing therewith and running down in rivulets.

In converting from coal to gas it was deemed advisable to install a fuel-oil stand-by system for emergencies, as the expected maximum hourly flows of 1,250,000 cu.ft., made sufficient reserve gas holders out of the question. With this in mind a 10,000-bbl. oil tank was erected and Forney high-pressure gas burners, which are quickly convertible to fuel-oil burning, were installed.

Several fears beset the operating force as to what results might be obtained when conversion to gas was finally accomplished. Among these was the question as to whether the superheat would be as high as with coal, as the furnace temperatures were expected to be 200 to 300 deg. F. lower than before, and less weight of hot gases would sweep over the tubes.

In practice, this fear has proved groundless, as the superheat has been consistently higher with gas firing than with coal. This increase, however, has not been



attributed solely to inherent superiority of the hot gases of combustion from natural gas, over those from coal, but rather to the fact that with gas the superheater tubes are clean on the outsides at all times, while they were continuously more or less incrusted with hard, baked ash when using West Kentucky coals. This ash could not be removed with steam soot blowers and as a result the superheaters were never really clean externally save immediately after the boilers had been out of service for periodic cleaning and inspection. Largely for this reason the average superheats are higher by about 30 deg. F. when firing gas than when firing coal.

Best operating efficiencies have been obtained with around 10.0 to 10.2 per cent CO_2, which corresponds to 15 per cent and 13.3 per cent excess air, respectively. Zero excess air corresponds to about 11.6 per cent CO_2 with the gas as fired.

The gas is orifice-metered with $2\frac{1}{2}$- and 8-pipe diameter connections to the differential and static pressure recording instruments. Corrections for gas temperature and specific gravity are made, static and differential pressures and temperatures being read for each hour from the charts, and the orifice coefficients corresponding to the particular orifice in use are employed in calculating total flows of gas for the twenty-four hour period. Each twenty-four hour chart is divided into three sections corresponding to the three eight-hour shifts in the boiler room, and the respective crews check the over-all boiler efficiencies by means of flow meters on the boilers.

Forced-draft to the burners is used on the four high-pressure boilers, while the eight low-pressure are operated on natural draft alone.

Several interesting problems came up in connection with the installation of the forced-draft burners. It had been decided to leave the underfeed stokers in position under the four high-pressure boilers in anticipation of possible future reversion to coal firing. Because of stoker and steam line interference in front, it was necessary, therefore, to place the burners either in the sides or in the rear of the settings. Rear wall-water screens on three of the boilers prevented placement in the back, and it was decided to put four burners on each side, making up sinuous air ducts to supply forced draft. This sinuosity was necessary because of interference of feed lines, stoker dumps, building steel and main steam lines.

Excessive congestion of steam lines on the sides of the clinker-grinder equipped boiler, which had no rear water screen, made it advisable to place the burners in the rear wall. This was done by making an unusually large number of turns in the air ducts to avoid the numerous obstructions.

In the case of the eight low-pressure boilers, the chain grate stokers were removed entirely, but the flat, suspended arches were retained in place and in their original positions.

The method of filling the coal-dropping pit and the ash hopper with cinders and flooring over with two courses of firebrick, edges up, to make 9-in. refractory floors is shown in Fig. 4.

A front view of the natural-draft gas burners with which the low-pressure boilers are equipped appears in Fig. 2. The large overhead pipe immediately in the center of the picture is the 12-in. steel main gas line running through boiler rooms. The smaller line immediately below is the 3-in. fuel-oil line supplying the low-pressure boilers. The rectangular ducts rising through the floors

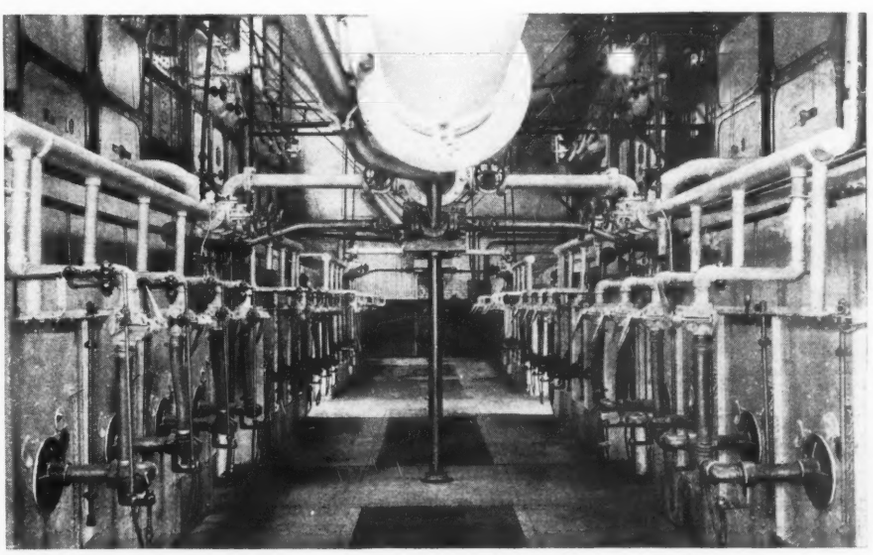


Fig. 2—Fronts of low-pressure boilers with burners in place

in Fig. 1 are for forced draft to the burner windboxes of two of the high-pressure boilers.

Each of the low-pressure boilers is equipped with four high-pressure convertible gas and mechanical-atomizing fuel-oil burners. Each burner is capable of handling 10,000 cu.ft. of gas per hour when supplied at 5 lb. gage. The total rating is, therefore, 40,000 cu.ft. per hour per boiler, which, with 960-B.t.u.-value gas, means a heat liberation of approximately 52,000 B.t.u. per cubic foot of furnace volume per hour. Fuel-oil burner ratings are the same in B.t.u. per hour as the gas burner. No serious difficulties have arisen in connection with furnace refractories at these rates of heat liberation.

Gas firing has reduced refractory maintenance to around 20 per cent of that incidental to stoker firing. This is attributed to the combination of lower furnace temperatures and absence of fly ash.

Three of the four high-pressure boilers are equipped with eight burners (four on each side), having a normal gas-burning capacity of 15,000 cu.ft. per hour each with 5 lb. gage pressure. The other high-pressure boiler is equipped with nine burners of the same capacity, firing being done from the rear, as shown in Fig. 3.

At these rates of gas flow, 120,000 cu.ft. per hour, the heat liberation per hour per cubic foot of furnace volume is around 35,000 B.t.u. for the eight-burner boiler, the furnace volume having been reduced from the original 3,600 to 3,300 cu.ft. because of coverage of the stoker tuyères.

The four high-pressure boilers, however, normally are operated at around 100,000 lb. of steam per hour each, at which rates the gas consumption per burner is around 20,500 cu.ft. per hour and the heat liberation per cubic foot of furnace volume is from 48,000 B.t.u. to 50,000 B.t.u. per hour, depending somewhat on varying feed-water temperatures and over-all efficiencies.

Around 110,000 lb. steam per hour is the maximum for the eight-burner boilers, while 120,000 lb. is the maximum for the nine-burner boiler. At these ratings the heat liberation in the furnaces is around 53,000 to 55,000 B.t.u. in the first case and 57,000 to 60,000 B.t.u. per cubic foot in the latter.

Considerably higher heat liberation could no doubt be carried on without undue refractory deterioration were it not for stack-draft limitation, which prevents operation at materially higher rates without furnace pressures.

The heating value of the gas at 60 deg. F., 30 in. Hg. base, is 960 to 980 B.t.u. per cubic foot, and its cost makes it competitive with coal.

From every viewpoint gas firing has been satisfactory. Thirteen less operators and three less maintenance men are employed; furnace repairs have been reduced to around 20 per cent of costs with coal; stoker repairs have been eliminated, and burner maintenance is only a very small fraction of that for stokers. Coal- and ash-handling equipment maintenance has been eliminated, and the B.t.u. per kilowatt-hour of station output is, on an average, 5 per cent lower than with coal. This is due to slightly higher average over-all boiler efficiencies and higher superheats, resulting in lower turbine water rates.

Continuous steaming rates 10 per cent higher than with coal are possible, due to smaller volume of gases passing through the settings (with a resultant lower draft loss per million B.t.u. of furnace liberation) and to cleaner gas passage through the tubes offering less restriction to flow. Setting draft losses and chimney drafts were the limiting factors with coal, and this limit has been raised with gas for the above reasons.

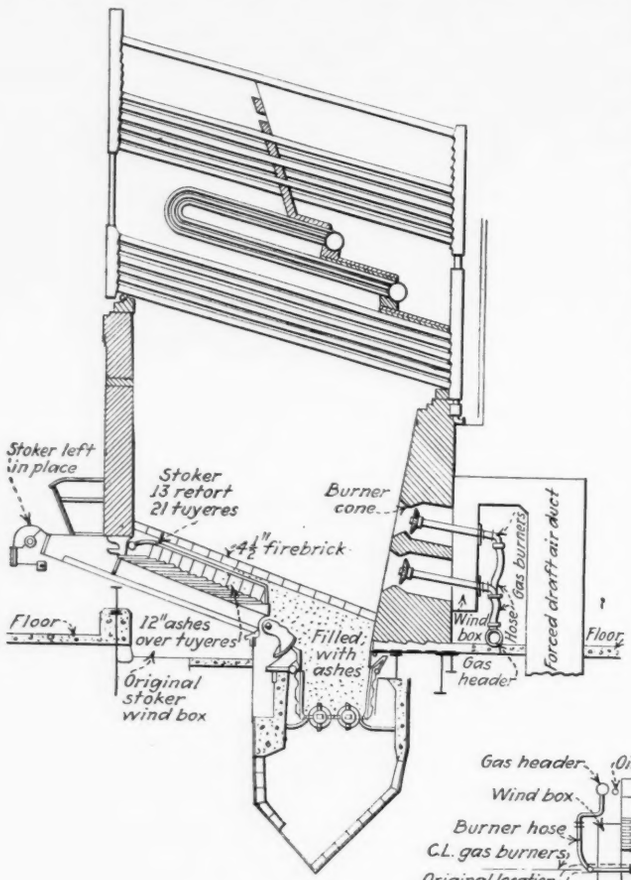


Fig. 3 (Above)—Burner arrangement on high-pressure boiler having a clinker grinder

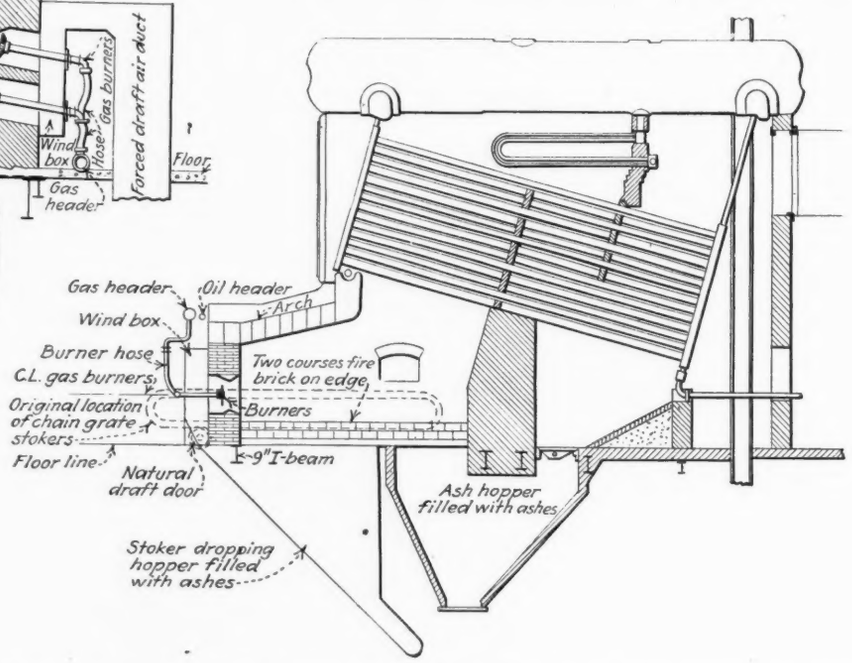
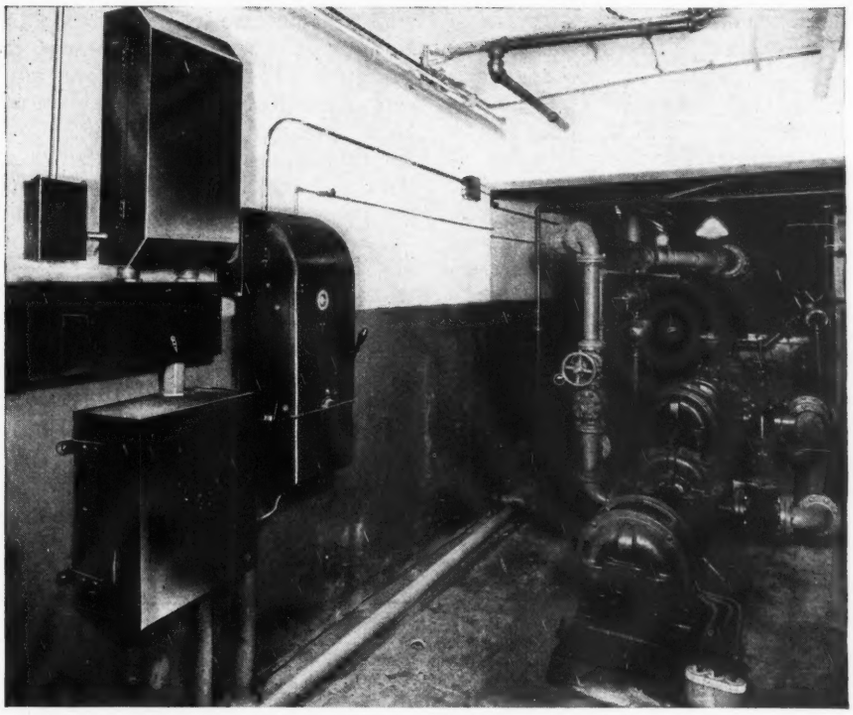


Fig. 4 (Right)—Method of installing gas burners on the low-pressure boilers



Compensator - type starter provides overload and undervoltage protection to squirrel - cage motors

PROPER PROTECTION SAVES THE MOTOR

How induction motors are protected against overloads, single-phase and reverse-phase operation, and undervoltage. The protective equipment includes fuses, thermal cutouts, thermal, electromagnetic and reverse-phase relays

By A. HOLT
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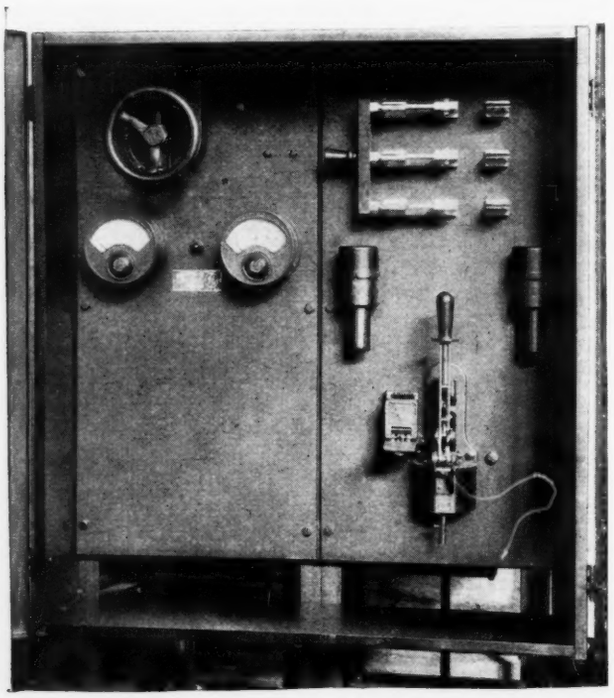
MOTORS designed for continuous operation with a 40 deg. C. rise in temperature can continuously carry an overload of 15 per cent. The service factor marked on some motor nameplates indicates the percentage of rated load that may be carried. For a 40 deg. C. rise motor the service factor is 1.15, or 115 per cent. A 55 deg. motor is rated at its maximum output, no allowance being made for permanent overloads. An ambient air temperature of 40 deg. is specified for motors. A polyphase motor will not start single-phase, but will generally continue to run if one phase is opened. A three-phase motor will deliver about 70 per cent of its rated output at normal temperature rise when operated single-phase. The speed will be little affected, but the pullout torque will be decreased 25 to 35 per cent.

Being the earliest contrivance available, and also because of its inherent simplicity and reliability, the fuse is commonly used for motor protection. Approved 250- and 600-volt fuses are made in sizes up to 600 amp. If a larger fuse is needed two or more may be operated in parallel, but this method is not reliable, because the several fuses may not continuously properly share the current, due to slight differences in voltage drop. The circuit is thus apt to be opened by a current less than that indicated by the sum of the fuse ratings.

According to the national electrical code, fuses for running protection must not exceed 125 per cent of a motor's continuous ampere rating. For a 55 deg. C. rise motor the continuous ampere capacity is stamped on the nameplate. The 40 deg. motor is 1.15 times its nameplate ampere rating. Thus 125-amp. fuses would be required for running protection of a motor having a continuous full-load current of 100 amp. Approved fuses, however, must carry 110 per cent of rated current continuously without deteriorating, hence the 125-amp. fuse would not melt until the current was main-

tained at 140 or 145 amp. for several minutes, the exact current and time depending on the fuse's construction, assuming that there is no heating due to a poor contact. A current of 185 amp., or 185 per cent of the motor's full-load current, corresponding to 148 per cent of the rating of the fuse, would cause it to blow in approximately one minute. A 125-amp. fuse will carry 300 amp. for approximately 8 sec. Such overloads as these, from 40 to 200 per cent, can safely be carried by most motors for longer periods than permitted by the ordinary fuse, if small enough to afford protection from single-phase operation.



Fire-pump control panel for 200-hp., slip-ring motor includes overload and undervoltage protection

If a 100-amp. three-phase motor continues to carry full load when operating single phase, due to the blowing of one fuse or to the breaking of a conductor, its current will increase to approximately 170 amp., and early blowing of the required 125-amp. running fuses can be expected. If the fuses were rated at 150 amp. or above, blowing might not result from single-phase operation, thus causing a burn-out. If the motor's output is but 70 per cent of normal, single-phase operation will not cause overheating, because its current will not exceed the full-load value.

There has recently been developed a super-lag fuse in which the time lag is increased by thickening part of the link by spot-welding strips of zinc thereto.

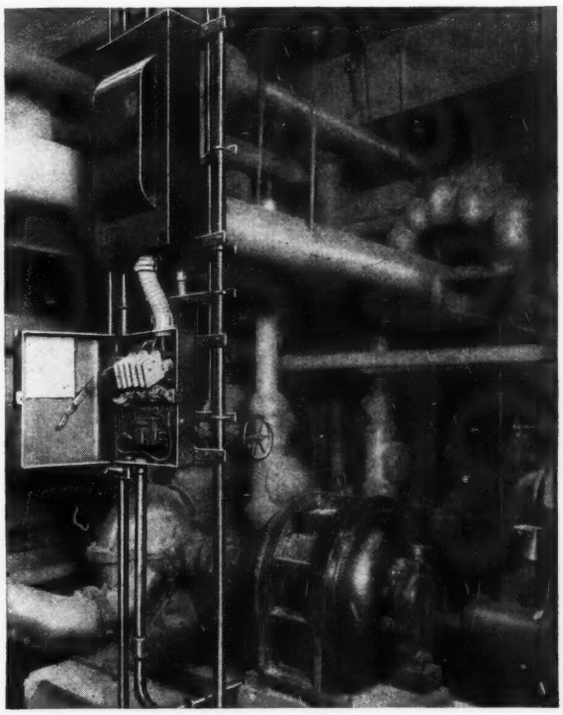
To function properly, a fuse, regardless of the type, must not become heated. Connections to the fuse clips must be clean and tight, and the fuse clips must be kept in good condition, particularly if of the ferrule type. The spring tension in the clips, which is necessary to insure good contact, will eventually disappear as a result of heating. If fuse clips must be replaced, only sturdy ones should be used. All fuse clips on the market are by no means equally well constructed. A fuse carrying the permissible load of 110 per cent of its ampere rating will feel hot if touched, since with this current the allowable temperature rise is 70 deg. C. above a room temperature of 32 deg. C. Fuses should not be operated continuously at maximum temperature; but one of higher rating should be used to obtain cooler operation. When replacing links in renewable fuses, now almost universally used, good contact must be made and the shell should not be overloaded. In some cases the time lost in replacing a blown fuse is an important item. This, together with the inability to properly carry safe motor overloads, limits the use of fuses for motor protection.

If all or a proportional part of the motor's current flows through a heating coil close to a fusible link a modified type of fuse, termed a thermal cutout, is formed. Release of the fusible link by melting allows a contact to spring open, thus opening the circuit. The fusible links are easily replaced and are inexpensive. Thermal cutouts can be made to have almost any desired time-current characteristic. As ordinarily constructed, 130 per cent of rated current will be carried for approximately 6 min. and 300 per cent of rated current for 45 sec. Thermal cutouts are made in various sizes up to 20 amp. for 600-volt service. These devices are suitable for the protection of small motors, and the fusible links can be

Fused jack - type disconnect-switches combined with magnetic switches form unit starters and protection for induction motors. Motors are started and stopped from remote push buttons

replaced more quickly than a fuse can be reloaded. As with a fuse, the current-time characteristic cannot be adjusted.

In a temperature overload relay a thermostatic strip is deflected by heat due to the motor's current. The relay has sufficient thermal capacity to carry safe motor overloads. When the overload is of such duration and magnitude as to cause the motor to overheat, the deflection of the thermostatic strip opens a contact connected in series with the compensator's undervoltage coil, or



Fused safety switch and thermal overload relays on magnetic starter protect squirrel-cage motor

magnetic contactor's coil, thus opening the main circuit. Most types of temperature relays must be reset manually. This can be done only after the thermostatic strip has cooled sufficiently to remain latched. The time required to cool is usually less than a minute, during which the motor is also being cooled.

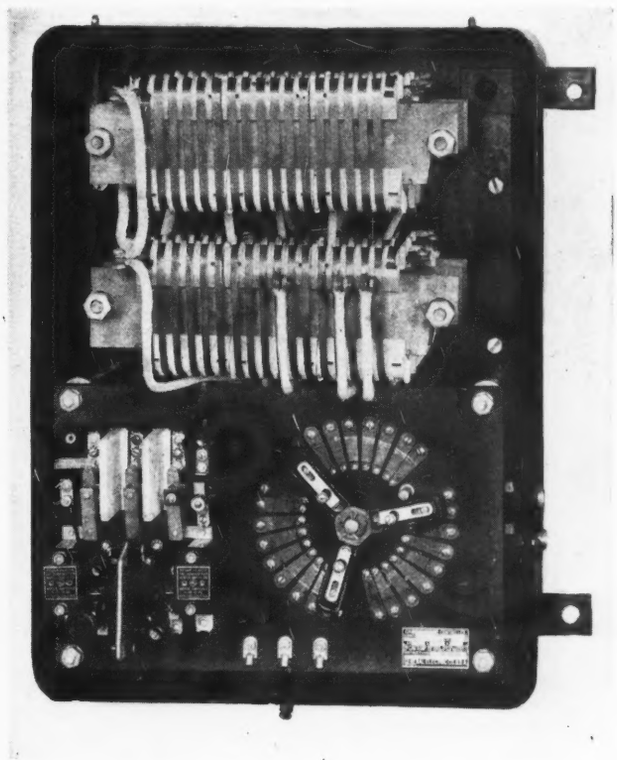
Some types of temperature overload relays are provided with a calibrating arm by which the current setting can be varied from 80 to 120 per cent of the relay's nameplate current rating. Certain small-capacity types are made in the form of a cartridge fuse, but generally one or two relays are mounted on an insulated base. Two temperature overload relays, arranged to open a common contact are required to protect both two- and three-phase motors.

Temperature overload relays are made in sizes up to 300 amp. for 600-volt circuits. Proper protection cannot be obtained unless the relay suits the motor. When the current setting is 100 per cent the relay will eventually trip with a current 100 per cent of its nameplate rating, with a room temperature of 40 deg. C. To function properly the relay must be influenced by the same ambient air as the motor protected. The relay setting should be not more than 110 per cent of the motor's continuous rated current. Due to its simplicity and sturdiness and controllable current-time characteristics, the temperature overload relay is now extensively used to protect induction motors. The ideal thermal relay would be one attached to the motor, and responding to its maximum temperature. The scheme has not been used extensively because of expense and complication.

Plunger-type relays have been employed to protect induction motors for many years. The time characteristic is adjustable, and is obtained by an air bellows or oil dashpot attached to the plunger. Current adjustment is by a movable core. Relays of this type when applied to induction motors usually have an inverse time characteristic, somewhat as is inherent in fuses and thermal relays. In some types the contacts are quickly opened by the breaking of a toggle joint when struck by the plunger rod; in others the contacts are mounted on the plunger rod, the quick-break feature being absent.

If air bellows are used as the time element in these relays, trouble may result from air leaks due to cracking of the leather. Neatsfoot oil should occasionally be applied to prevent this. When the time delay is obtained from oil-filled dashpots trouble will be encountered due to the oil's becoming dirty or gummy unless frequently changed. This condition may prevent the opening of the relay contacts on overload, or cause them to remain open instead of resetting automatically.

Undervoltage protection is usually obtained by the release of a core armature due to the decrease in flux



Thermal overload protection combined into speed control for slip-ring induction motor driving fans

occasioned by a voltage 50 to 70 per cent of normal. This protection may be instantaneous, or a time delay of a few seconds may be introduced by a simple device. Local conditions and the nature of the motor's load determine the allowable time delay. If magnetic switches are employed they, of course, drop open upon the occurrence of undervoltage.

Induction motors are sometimes protected against damage from single- or reverse-phase operation by an instantaneous relay. For the majority of applications

this refinement is not necessary. Relays for the protection of induction motors must be reliable, substantially constructed and inexpensive. High accuracy can be obtained, but current and potential transformer must generally be installed with them. Such expense and complication are warranted only for very large motors or for special applications.

Overload relays should be set as low, both as to time and current, as possible, yet high enough to prevent unnecessary interruptions. Cut-and-try methods are generally followed to determine the proper setting, because suitable test equipment is rarely available. If the overload relays are in circuit both during starting and while running they must obviously be set high enough to permit starting the motor. If the relays are operative only while the starting compensator is in the running position a current setting of from 125 to 150 per cent of the motor's rated current and of 30 to 60 sec. is generally satisfactory. If the current setting is greater than 170 per cent of the motor's continuous full-load current protection from heating due to single-phase operation will not be had. The proper settings can be found by obtaining a record of the motor's ampere input, preferably by means of a curve-drawing ammeter, when most heavily loaded and when the voltage is mimimum. Markings enable one to set the relay for the desired tripping current, but the operating time must generally be fixed by using a stop watch or electric timer.

▼ ▼ ▼

Remote Control Successfully Applied to Constant-Volume Turbine Governor

By A. P. MANSFIELD
General Electric Company

A MIDWEST industrial plant recently installed two blast furnace compressor units having a capacity of 50,000 to 70,000 cu.ft. per minute at discharge pressures ranging from 20 to 30 lb. per square in. gage. The compressors are driven by direct-connected, multi-stage, 7,900-hp. condensing turbines designed to operate with steam conditions of 225 lb. gage, 250 deg. superheat, and exhausting against 1 lb. abs. back pressure.

The compressor units are equipped with constant-volume governors designed to regulate the speed of the turbines so that the volume of air delivered to the furnaces will be constant irrespective of the resistance of the furnace. This equipment represents standard blast-furnace practice, but the engineers desired apparatus which would give complete control of the compressor units to the blast-furnace superintendent rather than to the station operator.

It is customary for the blast-furnace superintendent to signal the station operator for the air requirements of the furnace, but in this installation the furnace superintendent can set the volume of air to be delivered by the compressors and manipulate the machines during checking and casting. The apparatus required to perform these operations is shown diagrammatically in Fig. 2, and the constant-volume turbine governor is shown in Fig. 1.

The constant-volume governor *H*, Fig. 2, is equipped with a sliding weight, which is ordinarily set manually to cause the compressor to deliver the required amount of air. But it is equipped with a small split-field motor so that the setting may be accomplished electrically from

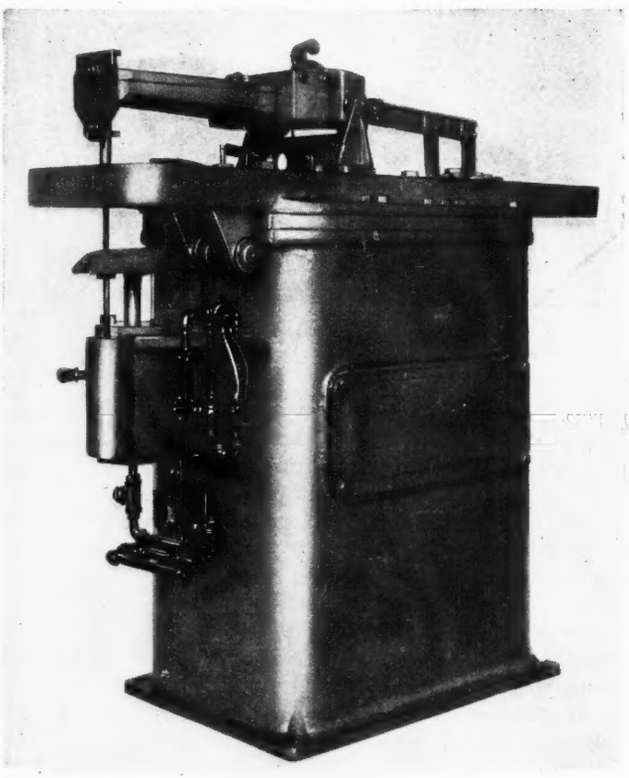


Fig. 1—Constant-volume turbine governor

stations *D* either at the blast furnace or by the operator at the compressor. The volume of inlet air delivered by the compressor is shown on volume indicator *G*. This gage consists of a device for showing the pressure drop across an orifice placed in the inlet air conduit to the compressor. It is calibrated in cubic feet of air per minute and is provided with a scale by means of which the inlet air volume can be adjusted so that the oxygen content will correspond to that calculated for standard conditions to agree with the other components of the charge in the furnace. Indications of this volume are

also shown on indicating volume meters *A*. These readings are also recorded on a 24-hr. chart, together with the corresponding blast line pressure, by graphic meters *F*. The latter are equipped with Selsyn transmitters, so that the records of volume and pressure are duplicated at the blast furnace, and the volume is also indicated on similar instruments, designated as *A* both

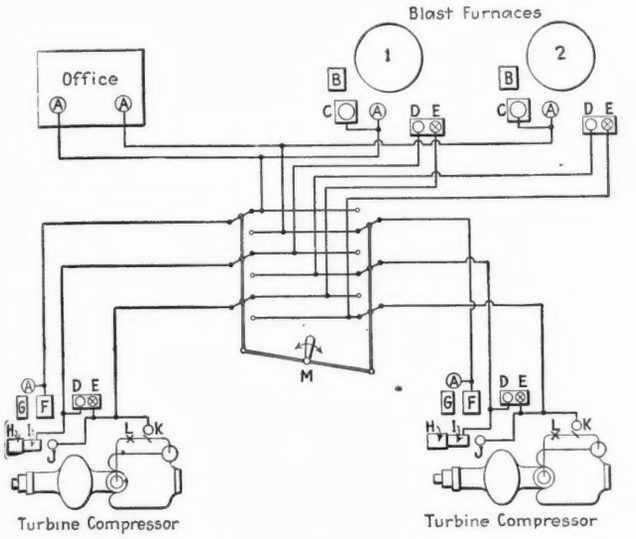


Fig. 2—Diagram of remote control of constant-volume governor

at the blast furnace and in the engineer's office. At each furnace there is a volume-correcting scale by means of which the blast-furnace operator can determine the actual inlet volume necessary for the existing atmospheric conditions and the charge in the blast furnace. Then, having done this, he is able, by manipulating switch *D*, to operate volume-setting motor *I* and in this way adjust the constant volume governor to give him the required volume as calculated by *B* and indicated on instrument *A*.

When it is desired to reduce the blast pressure during casting, the superintendent manipulates switch *E*. This completes the circuit through solenoid-operated valves, which, in turn, operate an auxiliary loading device on the weight beam of the governor, slowing down the turbine to reduce the blast-furnace pressure to the desired amount. The slowing down of the turbine is accompanied by a simultaneous bypassing of the compressor openings by means of a solenoid-controlled hydraulically operated valve *K*. The amount of bypassing is adjusted by a gate valve, which is set so that the volume of bypassed air will be just sufficient to prevent the unit from pulsating when the flow of air is instantly reduced by the falling pressure in the system.

As soon as the casting operation is completed and full volume of air is again required by the furnace, the superintendent merely opens switch *E*, and the governor automatically restores the air supply to its original value without any further manipulation of the governor.

Provision is also incorporated for operating either compressor on either blast-furnace unit. The control is shifted to either blast furnace by means of transfer panel *M*, which performs all the operations indicated simultaneously. The station operator decides which compressor he will use to blow a particular furnace, and then shifts the control by means of the transfer panel so that the blast-furnace superintendent has full control of the machine without actually knowing which compressor is supplying air for his furnace.

Causes of Sag in Multiple V-Belt Drives

VERY frequently in a multiple V-drive one or more belts will sag to a greater degree than adjacent ones. Conclusions are that these particular belts are stretching badly. While this may in rare cases be true, the facts are usually that the sagging belts are a small fraction of an inch longer than the other belts and were so at the time of installation, or that the V-grooves in the sheaves are incorrectly cut.

Few engineers realize the large sag effect resulting from addition of a fraction of an inch to belt length. Where there are a number of belts transmitting the load it is desirable, but not of great importance from a standpoint of efficiency, to have all belts of an exact length. It is true, with a top belt sag, that with an increasing length of a belt and a resultant increased distance of sag, there will be a greater arc of contact on each sheave and hence a higher degree of power transmission. Considering the fact, however, that V-drives are figured for 180-deg. angle of contact, as a rule, with an efficiency of transmission as high as 98 per cent, there cannot on a standard drive be any great advantage in increasing the sag purposely.

A sag may appear to be quite great, yet it is not often considered how small may be the factor which creates it. For instance, take the question of difference in belt lengths. If the driving side is assumed without sag and a center distance between sheaves of 10 in. is assumed, a $\frac{1}{2}$-in. difference in length will give an approximate sag of 1.6 in., while a center distance between sheaves of 100 in. and a $\frac{1}{2}$-in. difference in length will produce a sag of 5 inches.

Belt stretch is not always the main cause for unequal sags in belts. V-belts are now usually built in such a manner that appreciable stretch is impossible. The greatest trouble is usually found in the sheave itself. If all grooves are cut correctly and are polished, seating action of the belt will take place simultaneously in each belt of the drive. If, however, the angle of one or both sides of the groove is incorrect, rust or foreign material may be deposited on one or both sides of the groove; or if the sides of the groove are roughly machined, certain belts will ride high in their grooves. Both conditions tend to increase the length of particular belts. Other belts will then have the appearance of sagging.

—R. E. S. Geare in *American Machinist*.

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IN THE LIST of new equipment installed in the Hawthorne plant of the Western Electric Company and described in the Dec. 2 number of *Power*, the turbines driving the boiler-feed pumps were inadvertently referred to as "Winton." This was an error, the correct name being Whiton.

Effect of Excess Air on Chain-Grate Stoker Operation

By E. C. CAWRSE
Cleveland Electric Illuminating Company
Cleveland, Ohio

IT IS generally believed that an increase in excess air above the minimum consistent with good combustion of the gaseous products will result in an increase in stack loss greater than the ashpit loss decreases. Results of recent tests on chain-grate stokers show that this is not a general characteristic. The equipment tested consisted of:

1. Natural-draft chain-grate stokers without coking plates, firing Stirling boilers with 6,860 sq.ft. of heating surface and equipped with convection-type superheaters, economizers and two-speed induced-draft fans. These stokers are 12 ft. wide x 15 ft. long and are driven through a lineshaft by a steam engine.

2. Natural-draft chain-grate stokers with coking plates, firing the same sized boilers and having the same auxiliary equipment. These units are 12 ft. wide x 12 ft. 6 in. long.

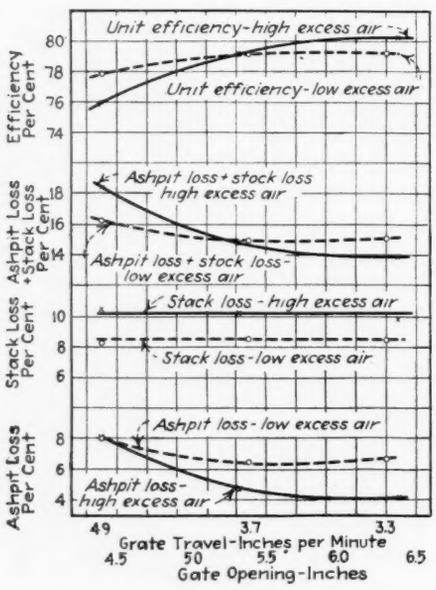
3. Forced-draft chain-grate stokers with four-compartment forced draft, firing Stirling boilers with 6,860 sq.ft. of heating surface equipped with superheaters but without economizers. These units are 12 ft. wide x 12 ft. long and are also driven through a lineshaft by a steam engine.

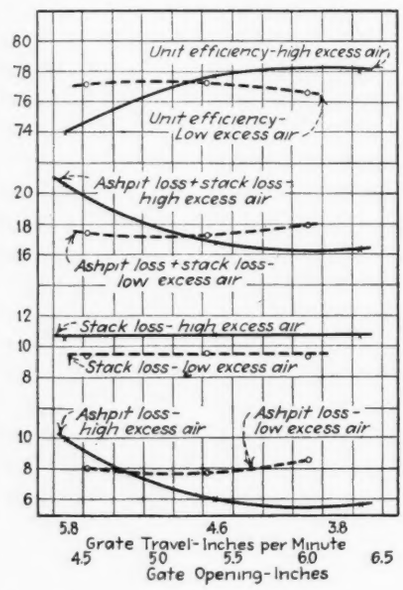
Tests on natural-draft stokers without coking plates were run simultaneously on two units in order to have a good check on the final result. Each test was of five hours' duration, the series consisting of runs with nominal 4.5- 5.5- and 6.5-in. coal-gate openings and with nominal excess air allowances of 45 and 65 per cent.

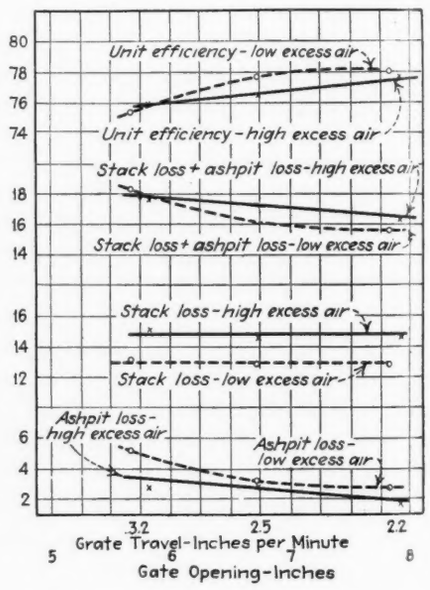
The per cent excess air was determined by Orsat apparatus connected to the last pass of the boiler, sampling four points simultaneuosly. The gas temperature leaving the economizer was determined from a recorder, which was calibrated during each test. In arriving at the stack loss gas temperatures were corrected to a standard elapsed time between soot blower operations, and the excess air was corrected for infiltration between boiler and economizer outlets.

Coal samples were taken hourly from chutes installed in the coal spreaders. The table shows the proximate analysis and fineness grading of the coal used during the tests. It was slack coal from Pittsburgh and Ohio No. 8 seam having an ash softening temperature of about 2,150 deg. F.

Ash samples were taken at the end of each test with







FIGS. 1 AND 2—RESULTS OF TESTS ON NATURAL-DRAFT CHAIN-GRATE STOKERS WITHOUT COKING PLATES

17 pounds of coal per square foot of grate surface per hour, moisture in coal 5.1 per cent

21 pounds of coal per square foot of grate surface per hour, moisture in coal 4.9 per cent

FIG. 3—RESULTS OF TESTS ON FORCED-DRAFT CHAIN-GRATE STOKER

25 pounds of coal per square foot of grate surface per hour, moisture in coal 8.9 per cent

three specially constructed pipes 3 in. in diameter by about 7 ft. in length and sealed on one end. The procedure used in obtaining the sample was to move the open end of the pipes about in the ash stream as the ashes were being removed from the overhead hoppers. When the pipes became full they were emptied on a clean-swept floor and a second sample was taken. This method was followed until all the ash for the test had been removed. The sample obtained amounted to about 4 per cent of the total ash.

Pertinent data for the tests are shown in Figs. 1 and 2. These curves, which are composites of the results obtained on the two units, clearly show, for the particular coal being burned, that best performance is obtained with a thick fuel bed and an excess air allowance of 60 to 65 per cent. Boiler unit efficiencies were obtained by the method of losses.

After completing this series of tests some experimenting was done to determine the extent to which the coal should be tempered for best results. It was found that with a total moisture content of 8 to 9 per cent the ashpit loss was improved some 1.5 to 2.0 per cent over that with coal as received.

Following the same procedure as on the stokers without coking plates tests were run on the coking-plate type stoker with coal as received at nominal 120 and 160 per cent ratings, corresponding to combustion rates of 20 and 28 lb. of coal per square foot per hour, with

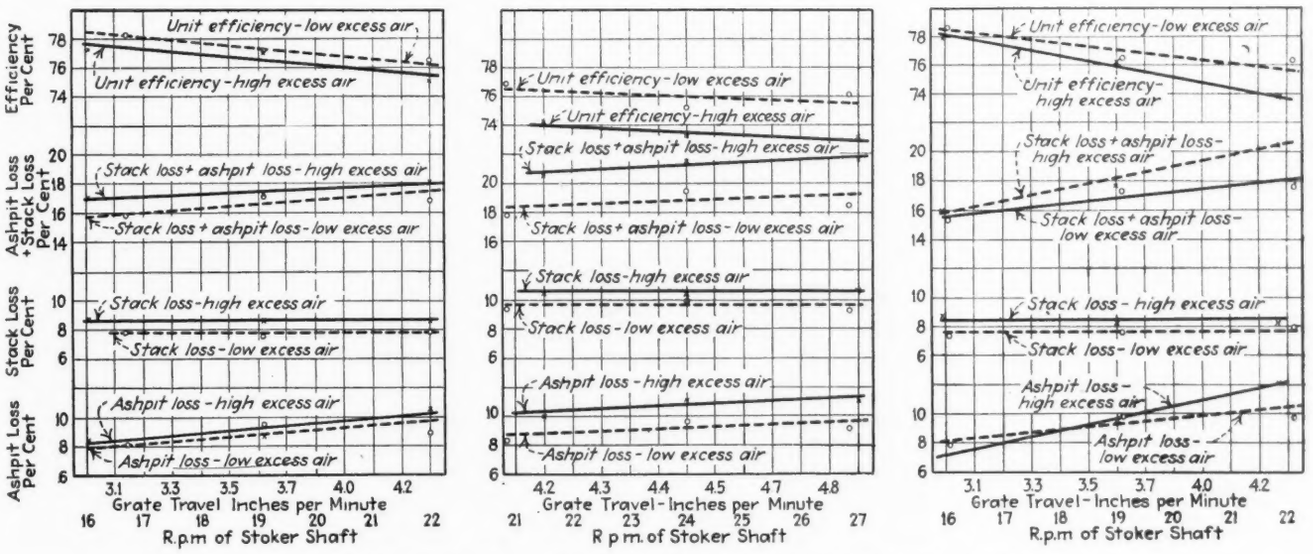
PROXIMATE ANALYSIS AND FINENESS GRADING OF COAL USED IN TESTS

Pittsburgh and Ohio No. 8 Slack. Ash Softening Temperature About 2,150 Deg. F.

Coal Analysis:	Tests on Natural Draft Stokers Without Coking Plates	Tests on Natural Draft Coking-Plate Stokers With Coal as Received	Tests on Natural Draft Coking-Plate Stokers With Coal Tempered	Tests on Forced Draft Stokers
B.t.u. as fired	12,712	13,065	12,545	11,466
B.t.u. dry	13,372	13,562	13,590	12,579
B.t.u. moisture and ash free	14,920	14,900	14,850	14,710
Total moisture, per cent	4.93	3.68	7.68	8.85
Volatile combustible, per cent	32.5	36.5	36.9	33.3
Fixed carbon, per cent	57.1	54.5	54.6	52.2
Ash, per cent	10.4	9.0	8.5	14.5
Total (dry basis)	100.0	100.0	100.0	100.0
Sulphur, per cent	2.1	2.6	2.5	3.2
Coal Fineness Grading:	**Per Cent**	**Per Cent**	**Per Cent**	
Over 1.050-in. mesh screen	2.5	0.1	0.1	Not determined for these tests
Over 0.742-in. mesh screen	18.3	11.0	12.8	
Over 0.525-in. mesh screen	36.3	23.5	27.4	
Over 0.263-in. mesh screen	64.2	46.5	53.2	
Over 0.131-in. mesh screen	76.9	64.4	68.8	
Over 48-in. mesh screen	90.5	89.7	91.7	

results were obtained with a heavy fire and slow grate speed; but excess air should be kept low and the coal should not be tempered.

That the coking-plate type stoker cannot operate with beneficial results with increased excess air is probably explained by the nature of the fuel bed. The stokers without coking plates, with gates in good condition, usually maintain a very even fuel bed. On the coking-plate stoker the fuel bed is more or less irregular, be-


Efficiency Per Cent
Unit efficiency - low excess air
Unit efficiency - high excess air
Ashpit Loss + Stack Loss Per Cent
Stack loss + ashpit loss - high excess air
Stack loss + ashpit loss - low excess air
Stack Loss Per Cent
Stack loss - high excess air
Stack loss - low excess air
Ashpit Loss Per Cent
Ashpit loss - high excess air
Ashpit loss - low excess air
Grate Travel - Inches per Minute
R.p.m. of Stoker Shaft
Unit efficiency - low excess air
Unit efficiency - high excess air
Stack loss + ashpit loss - high excess air
Stack loss + ashpit loss - low excess air
Stack loss - high excess air
Stack loss - low excess air
Ashpit loss - high excess air
Ashpit loss - low excess air
Grate Travel - Inches per Minute
R p m. of Stoker Shaft
Unit efficiency - low excess air
Unit efficiency - high excess air
Stack loss + ashpit loss - high excess air
Stack loss + ashpit loss - low excess air
Stack loss - high excess air
Stack loss - low excess air
Ashpit loss - high excess air
Ashpit loss - low excess air
Grate Travel - Inches per Minute
R.p.m. of Stoker Shaft

FIGS. 4, 5 AND 6—RESULTS OF TESTS ON NATURAL-DRAFT CHAIN-GRATE COKING-PLATE STOKERS

20 pounds of coal per square foot of grate surface per hour, moisture in coal 3.5 per per cent

28 pounds of coal per square foot of grate surface per hour, moisture in coal 4.1 per cent

20 pounds of coal per square foot of grate surface per hour, moisture in coal 7.7 per cent

nominal excess air allowances of 40 and 60 per cent and with variable fuel bed thicknesses. The gates on these units were set at 8 in. and the fuel bed thickness was controlled by the pusher stroke. The test series at each rating were run with three different grate speeds and the pusher stroke was adjusted to give the rating desired. For the coal-tempering tests the 120 per cent rating series was repeated with coal tempered to about 8 per cent moisture.

Composite curves showing the results obtained for the coking-plate type stokers are given in Figs. 4, 5 and 6. As with the stokers without coking plates, best

cause irregular coking of the coal on the plates; hence with the agitation of the plates and the pusher sections the coal is often dropped on to the grate in a lumpy condition. Air for combustion, in passing through the grates, chooses the path of least resistance and burns holes through the fuel bed at its weakest spots. Increasing the excess air allowance serves only to aggravate this condition.

A comparison of Figs. 4 and 6 shows that, for coking-plate stokers, no gain is made with tempered coal. With wet coal there is a greater tendency for the coal to feed irregularly from the coking plates, so that any

benefit that might be derived from the tempered coal is lost because of the unevenness of the fuel bed through which holes are burned.

Test procedure for the forced-draft stokers was the same as for the natural-draft stokers, except that four units were tested simultaneously and the excess air allowance for each test was determined from calibrated boiler meters.

Tests were run at 150 per cent rating, corresponding to a combustion rate of 25 lb. per square foot, with nominal 5.5-, 6.5- and 7.5-in. coal-gate openings and with nominal 40 and 60 per cent excess air.

Coal for this series of tests, for which a proximate analysis is shown in the table was tempered to about 9 per cent moisture, which had previously been found to give best results.

A composite curve showing the pertinent data is given in Fig. 3. With the particular coal being burned, best operations for this type of unit are to be had with 40 per cent excess air, a fuel bed thickness of 7.5 to 8.0 in. and with coal tempered to about 8 or 9 per cent moisture. These units showed best results with 40 per cent excess air rather than 60 per cent, because of zone control of the fuel bed. The results can readily be seen by comparing the difference in ashpit losses for the forced-draft and the natural-draft units for the two excess air settings, Figs. 1 and 3.

It should be specifically understood, of course, that the results of the foregoing tests apply to the particular conditions only. Coals with different fineness grading or clinkering characteristics can be expected to show different characteristics. The rates of driving at which the tests were run cover normal operation. The lower excess air is limited by smoke and refractory conditions.

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A New European Boiler Type

By ARNOLD WEISSELBERG

WHILE IN EUROPE last summer the writer was privileged to inspect the boiler laboratory of Keilmann & Voelker, Bernberg, Saxony, wel-known manufacturers of lignite firing equipment. Here persistent research work has been going on for the last five years to develop a boiler suitable for medium as well as high pressures and devoid of the faults of present-day boilers.

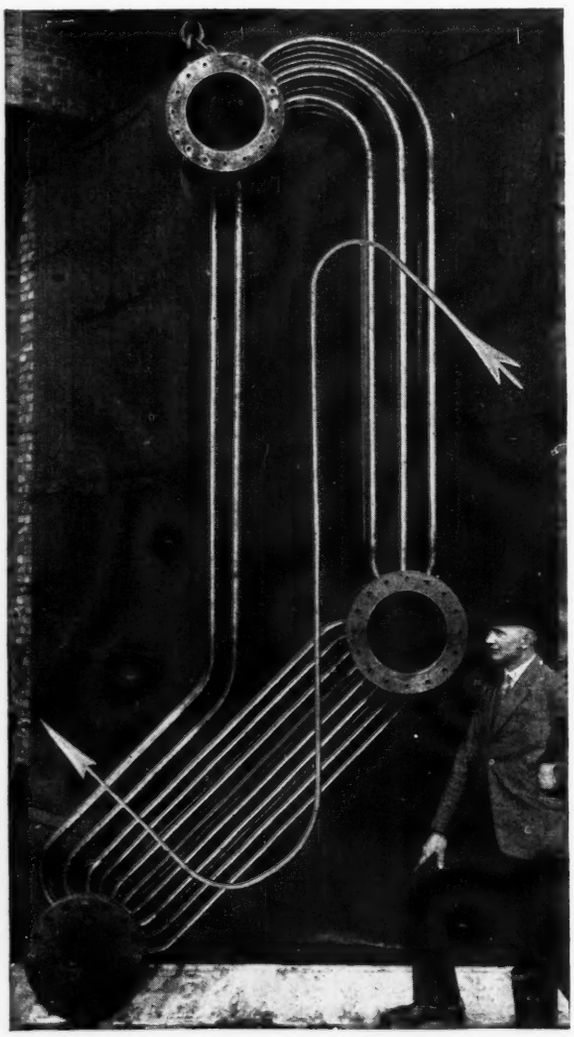
An interesting feature of the laboratory is that all the models have heavy glass observation ports which make the demonstrations very instructive. Among the models, ranging in sizes from 50 to 100 sq.ft. of heating surface, are also three-drum type and sectional boilers, built for comparison.

The main principles embodied in the development of a new boiler design here shown are, briefly, as follows:

1. The counter-flow principle, recognized as most efficient in any heat-exchange process.

2. The thermal pump principle, for the positive control of circulation.

The placing of the larger amount of heating surface in the lower bundle of tubes is in conformity with the second-mentioned principle. The ratio between the heating surface arranged in the lower and upper tube bundles depends on the operating pressure for which the boiler is to be designed. With higher pressures the heating surface in the lower bundle becomes larger.



The model shown here has 150 sq.ft. of heating surface and is built for 500 lb. pressure. It is oil-fired to permit quick changes in load. Even with an output equivalent to 1,100 per cent rating there were no signs of unstable circulation except at the beginning, at the time when the lower bundle tubes near the side walls were still comparatively cold. One could see through the observation port how the downward circulation in these outside tubes ceased as soon as they warmed up. The downcomers are for the greater part outside the pass of the flue gases, in accordance with good practice.

Research is still being carried on to leave nothing unexplained relating to the behavior of this boiler type and mainly to give the designer the data by which he will be guided in designing a boiler for certain operating conditions. Work is soon to begin on a large industrial installation.

Convenient Device For Cleaning Oil Coolers

By J. V. MACKENZIE
Mechanical Engineer
Consumer's Power Company

EFFICIENCY of oil coolers serving larger turbine-generators depends entirely on the amount of attention given to the cleanliness of tube surfaces. Labor required to thoroughly clean the tube bundle from a large cooler often is out of proportion to the results obtained, especially if ordinary methods are followed. To reduce the labor and to insure a satisfactory result was the ultimate aim in the design of the apparatus described here. It was necessary that the design be such as to permit the cleaning of tube bundles from oil coolers of units varying in capacity from 3,000 to 35,000 kilowatts.

Referring to Fig. 1, the tank for this washer is constructed of No. 12 gage sheet steel of a size sufficient to accommodate tube bundles from the largest unit in the station. A cover of the same material is provided and counter-balances are added to permit of easy access to the interior. This tank is mounted on a frame constructed of 2-in. angle iron. Caster wheels fitted to each leg of the frame allow of moving washer to any part of the station.

Two lengths of angle iron welded to the sides of the interior serve as a support for the bearing brackets, upon which the tube bundle assembly rotates. Each bracket is fitted with a bearing having a removable cap. The front bracket is bolted stationary to the pair of supporting angles, but the rear bracket is movable, holes being drilled at intervals along the supporting angles to permit adjustment of this bracket for tube bundles of various lengths. A worm gear assembly is bolted to the front end of the tank, with a short shaft projecting through to the interior which terminates in the male end of a square socket coupling. Power is supplied by a $\frac{1}{4}$-hp. motor, the speed reduction being such that the tube bundle rotates at about 50 r.p.m.

In Fig. 2 the manner of supporting the tube bundle is shown. There are two disks of approximately the same diameter as the tube bundle. A short shaft is keyed to each disk. One shaft is fitted with the female end of the coupling previously mentioned. The face of each disk contains several studs or guide pins so placed as to enter the tubes of the tube bundle. Two bolts that pass completely through the tubes permit of attaching a disk to each end of the bundle.

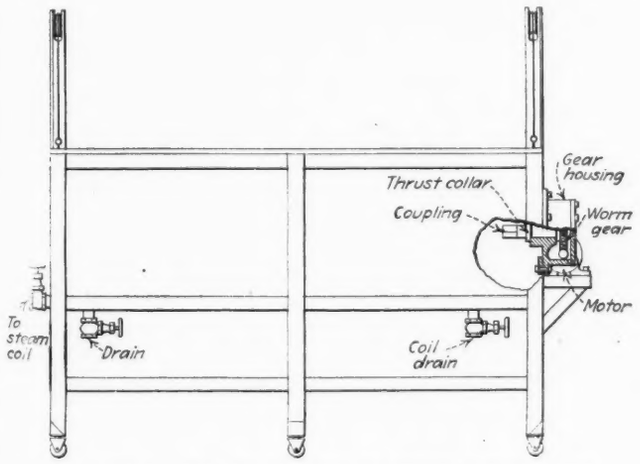


Fig. 1—Washing tank mounted on rollers and equipped with counter-weighted top

There is a steam coil in the bottom of the tank for heating the cleaning solution, a coil being used because a steam jet would weaken the solution by the amount of water added from the steam. A set of disks and retaining bolts is provided for each size of cooler.

The process of cleaning a tube bundle is as follows: The bundle is removed from the cooler shell in the usual manner, the disks are attached, and the complete assembly is mounted in the tank. The tank is then filled to about two inches below the center of the shaft with a solution of a commercial cleaner composed of sodium phosphate, sodium hydroxide and borax. A concentration of one pound of cleaner to five gallons of water has been found satisfactory. Steam is admitted to the heating coil and regulated to hold the temperature of the solution near the boiling point. The apparatus is then set in motion and allowed to run two to three hours, this length of time generally being sufficient to thoroughly clean the tubes. The solution is drained from the tank and, with the bundle in motion, water is sprayed on the tubes until all traces of cleaner have been washed away.

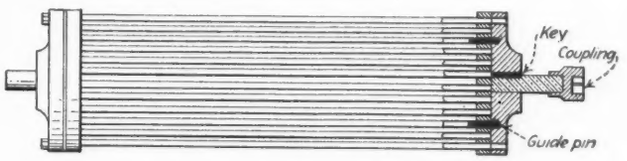


Fig. 2—Supporting tube bundle between end disks

Flue Dust Elimination At Colfax Station

THE COLFAX station of the Duquesne Light Company, a property of the Standard Gas & Electricity Company, and therefore a Byllesby subsidiary, is located fifteen miles up the Alleghany River from Pittsburgh, Pa., in the borough of Springdale. The plant contains eight large boilers, burning pulverized coal, in addition to fourteen stoker-fired boilers. On the plant side of the river the terrain is comparatively flat, but on the opposite side of the stream, about one-half mile distant, the bluffs rise to a height above the top of the stacks.

Consideration is now being given to the elimination of the dust nuisance, particularly from the pulverized-coal boilers. One of these boilers which discharges its gases into a stack in common with two others is being equipped with a Cottrell eliminator. After a thorough trial of this equipment it is the intention to equip the other seven pulverizerd-coal boilers with dust eliminators, a program that probably will extend over a period of five or six years.

After a study of the varied equipment designed to

eliminate flue dust, it was decided to equip one boiler with a Cottrell precipitator, to serve as a trial installation that would help determine future action. The boiler has a maximum output of 330,000 lb. of steam per hour and is rated normally at 280,000 lb. Bituminous coal from the Pittsburgh district is used, with the following average analysis as fired: Moisture, 3 per cent; volatile, 33 per cent; fixed carbon, 54 per cent; ash, 10 per cent; sulphur separately determined, 1½ per cent to 2 per cent; B.t.u. per pound as fired, 13,100.

A study of the possible layout made it evident that there would be no room on top of the boilers to place precipitators of such large size. In fact, this is one of the difficulties to be encountered in making such an addition to an existing plant. It was necessary to build a supporting steel structure adjacent to and outside the boiler room wall to support the precipitator at the level of the fan floor. The elevation from grade level to the bottom of the precepitator is 76 ft., and the precipitator itself is 25 ft. high. Approximately 180 tons of steel will be required to support the precipitator, which has a loaded weight, with the hoppers full of ashes, of 400,000 lb. The electrical substation is mounted on a steel structure at the boiler room operating floor level. The equipment is being placed in an air-tight room equipped for mechanical ventilation to keep dust from forming on the Bakelite arms of the mechanical rectifiers and thus prevent destructive arcing over. These precautions were taken to avoid one of the main sources of trouble in the operation of such a system.

The eliminator will consist of double units measuring in plan 25x25 ft. and 25 ft. high. The dual arrangement provides for cleaning one unit while maintaining the other in service. The dampers and scrapers are operated by compressed air. Each unit has fifteen ducts formed by division walls of Haydite cement, which has about two-thirds the weight of concrete. Duct dimensions are 12 ft. 10 in. long, 17 ft. 6 in. high and 8 in. wide.

In the substation there will be two transformer and rectifier units. Normally both units will be used, but in case of breakdown one unit will be large enough to operate the system. The rectifiers are of the mechanical type, driven by synchronous motors. The transformers are supplied with current from the 440-volt station auxiliary service. They are tapped so that an output voltage of 60,000 volts for the rectifiers may be stepped up to 75,000 volts if necessary.

At the maximum steam output of the boiler, 330,000 lb. per hour, the equipment will be required to handle approximately 165,000 cu.ft. per minute of flue gas at 450 deg. F. Under these conditions it is expected that the suspended matter in the exit gases from the precipitator will not exceed 10 per cent of the matter in the entering gas. In other words, a separating efficiency of 90 per cent is anticipated, and at lower boiler ratings the efficiency may increase to a maximum of 95 per cent.

What to do with the dust after collecting it was considered almost as much of a problem as its separation from the flue gases. Both wet and dry methods are in use. From the hoppers under the precipitators the dust may be discharged dry by gravity or by air suction created by a water jet. An alternative is to flush the ash down with water. If this plan is followed, care must be taken to avoid capillary effects at the point where the water is introduced, so that the material will not clog the line. For example, at the Trenton Channel Station of the Detroit Edison Company the ash is handled dry to a baffled box, where the water is introduced over inclined baffles to obtain an intimate mixture with the ash and is then carried off to an ash sluice or pit.

At the Colfax station the ash will be handled by an enactor system from the precipitator hoppers to an ashpit between adjacent boilers. The pit will be filled with water, and removal into motor trucks will be effected by a clam-shell bucket.

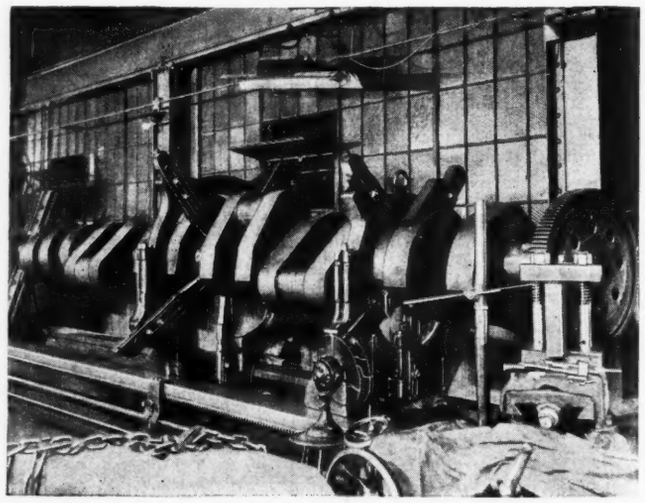
Method of Repairing A Broken Crankshaft

By ORVILLE ADAMS

WHEN oil- or steam-engine crankshafts break, the owner usually orders a new one, at a necessarily high expense. As a general rule, shafts can be repaired for not more than one fourth of their original cost.

Usually, the shaft is broken through a crank web, or the middle crankpin is broken, these two types of fracture comprising the majority of crankshaft failures, due in practically all cases to poor bearing alignment.

A Texas machine shop has worked out a satisfactory technique of repair. Solid forged shafts with broken webs have the web cut away completely from the crankpin and journal. The ends are turned accurately, and, by the use of the electric arc, a key-way is built on, instead of cut in, the shaft. A new forging is made, bored out to fit the ends of the shaft and crankpin. The piece is then shrunk on the shaft and pin. If properly done the result is as good as a factory built-up shaft.



Turning a shaft after repair

In repairing shafts that are broken through the crankpin, the pin is cut out, leaving holes in the webs to take a new pin. A crankpin forging is made and turned down to correct size. The two webs are shrunk onto the pin, which has been turned and polished to correct size.

While the shaft is in the shop a test is made, and if necessary it is straightened.

Although welded shafts are not acceptable for reinsurance, a repair as outlined meets the approval of all insurance companies.

Spray cools the circulating water for 500 kw. exhaust turbine

Fuel Bill Cut in Half By Exhaust Turbine

$50,000 spent for an exhaust turbine with associated condensing and electrical equipment in the Boston factory of Thomas G. Plant Corporation saves $16,000 yearly in fuel by utilizing the excess exhaust of reciprocating engines

SOMETIMES an industrial plant is so situated that large sums may be saved in operation by a moderate investment in special power equipment to work in connection with the existing installation. A case in point is the Thomas G. Plant Corporation factory in the Jamaica Plain district of Boston, Mass.

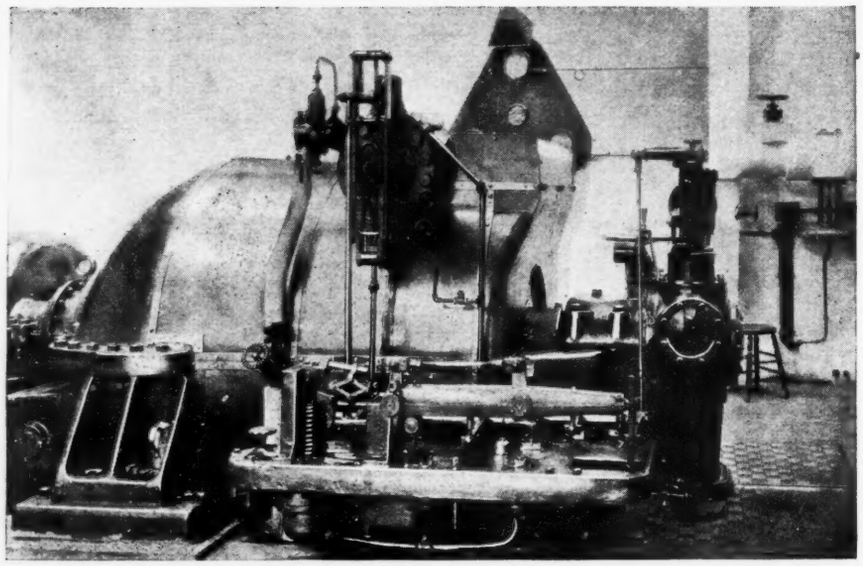
There a total sum of $50,790.52 spent to purchase and erect an exhaust turbine, condensing and spray cooling equipment, switchboard and all needed auxiliaries has cut the fuel oil bill in half, with an operating saving that will run about $16,000 in a year of normal business. This saving was possible because the existing non-condensing engines required steam far in excess of building heating requirements even in the coldest weather.

The present plant load is automatically divided between the two most efficient reciprocating units and the 500-kw. exhaust turbine to give a perfect balance at all times. That is, the steam passing to the turbine is at all times equal to the difference between the engine exhaust and the heating load. Condensing water for the exhaust turbine is cooled by a spray system installed in an existing storage pond.

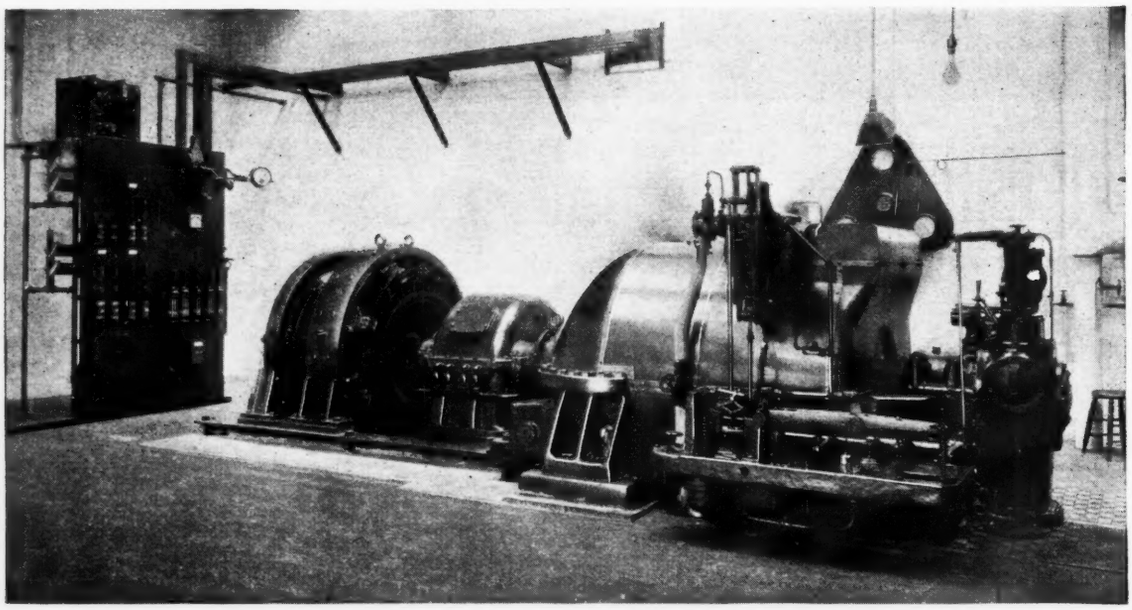
Through long years of operation the power plant had accumulated an assortment of reciprocating engines driving direct-current 110-volt generators. All exhaust not absorbed by the heating system blew to waste. The year 1927 saw marked changes in the organization of the company and in nature of its business.

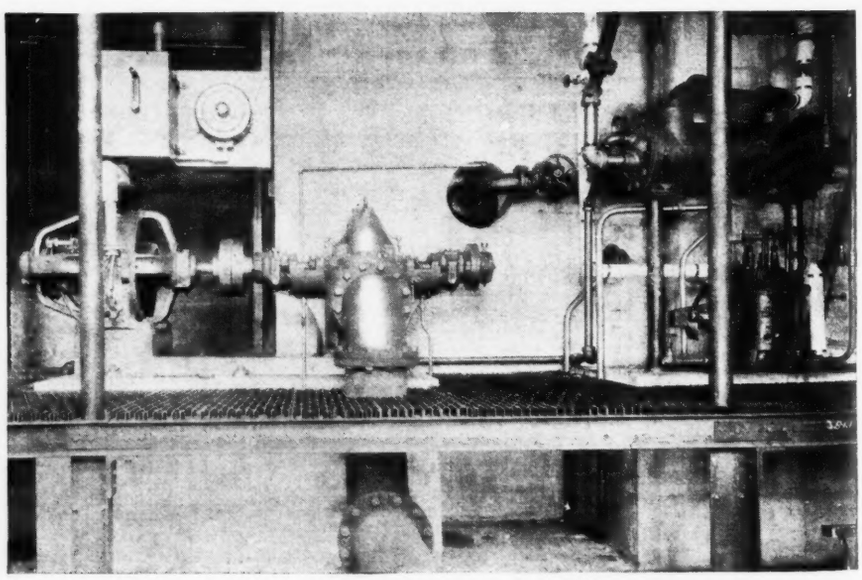
With new management came a reconsideration of proposals previously made for reducing the excessive cost of the power services. Particular attention was directed to the suggestion that a low-pressure condensing turbine be installed to utilize the waste exhaust of the reciprocating units.

C. W. Whiting of Boston was retained as consulting



Below is shown the 500-kw. geared direct-current turbine unit which utilizes the exhaust of reciprocating engines at a normal pressure of one pound gage. The amount of steam admitted to the turbine is automatically controlled to keep the engine back-pressure from rising to the setting of the atmospheric relief valve. A close-up of the turbine end is shown above





The 1,525-gal.-per-minute circulating pump shown at the left of the air evactor delivers cooling water to spray pond 100 yards away. This spray pond (pictured on the facing page) was made by converting a pond used for years to store pumped water for manufacturing purposes. Behind the wall here shown is a 1,350-sq.ft. surface condenser

engineer to investigate the possibilities and make specific proposals. After investigation he recommended the 500-kw. exhaust turbine as a means of producing a very large saving with a moderate investment. His figures indicated that the total investment would be in the neighborhood of $52,000 and that the resulting fuel and feedwater saving would be about $16,000 yearly with the expected electrical load and the then-existing fuel oil and water prices and boiler efficiency.

The great opportunity for saving money in this plant is explained in part by the high ratio of power demand to low-pressure steam demand. The only application for low-pressure steam is in building heat. To generate the proposed load with the reciprocating engines alone would require about 42,000 lb. of steam per hour, giving a usable exhaust (deducting 15 per cent) of around 36,000 lb. Of this the heating system would not use more than 9,000 lb. average in the coldest months.

As already indicated, the installation of exhaust-turbine equipment was made less costly by the existence of a water storage pond suitable for conversion into a spray pond by installation of sprays and piping. For years this pond, fed by an artesian well with air lift, had supplied the water needed for manufacturing.

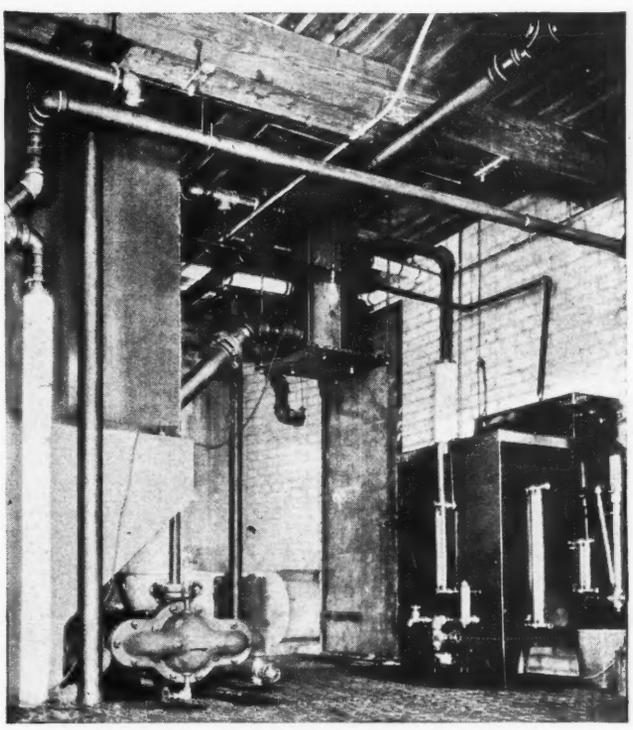
The operating savings made in this plant may be looked upon as salvage from waste exhaust steam. This view would be strictly correct if the installation of an exhaust turbine did not change the amount of steam exhausted by the engines. Additional power thus produced would have no fuel cost except for that required to drive the additional auxiliaries.

Actually, the power demand is fixed; the exhaust turbine necessarily takes load away from the reciprocating units. Thus the total steam to these units is lowered and this reduction is a measure of the real saving.

Since the original equipment is still in commission, it may be listed briefly: Steam, generated at 135 lb. by five 3,500-sq.ft. water-tube oil-fired boilers, is delivered to one or more of the six reciprocating engines direct connected to 125-volt direct-current generators.

These engines operate at 5 lb. back pressure with an average steam rate of about 45 lb. per kilowatt-hour. Vertical reciprocating feed pumps exhaust to an open heater, with the necessary steam make-up from the general exhaust system.

The new exhaust turbine is a geared direct-current unit of 500 kw. capacity. It receives steam at approximately 1 lb. pressure and exhausts at 28 in. average vacuum (70 deg. water.)



Turbine lubricating oil is purified in filter (right) operated on continuous bypass system

An important factor in plant economy is the dual governing of the unit by speed and by throttle pressure. If the throttle pressure rises, a pilot valve admits more steam regardless of the plant load. The turbine thereby takes some of the load from the engines. In this way no individual attention is required to prevent waste of steam through the relief valve (set at 5 lb.).

The turbine runs at 3,677 r.p.m. and the generator at 750 r.p.m., practically one-fifth turbine speed. Automatic voltage regulation is provided.

Exhaust steam passes from the turbine to a 1,350-sq.ft. surface condenser. A motor-driven circulating pump having a capacity of 1,525 gal. per minute, against 14 lb. pressure, forces water through the pond sprays, about 100 yards distant. A two-stage steam-jet evactor removes air from the condenser and delivers its condensate to the feed system through a trap.

Turbine oil is kept pure by constant operation of a recirculating filter connected to the turbine oil tank. Oil pressure is safeguarded by a turbine-driven oil pump which starts automatically if the direct-connected pump fails to maintain a certain pressure.

Steam enters the turbine from below after passing an oil separator. A reducing valve furnishes steam from the high-pressure system if the throttle pressure falls below 1 lb.

The platform around the turbine is a simple wood mill floor. This was constructed at very low cost by the plant force.

The significance of this story to *Power* readers lies in the fact that many non-condensing plants are still in operation where substantial amounts of steam are discharged to atmosphere. While some of these plants use all of the steam during the winter months, the summer waste is worthy of serious consideration.

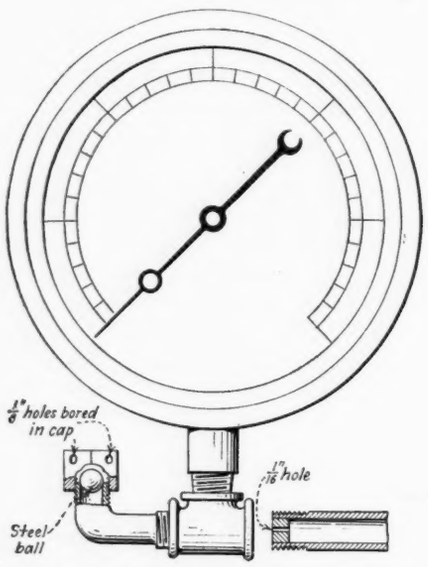
Many of such plants could achieve substantial savings by means of an exhaust turbine. Others may justify a diesel installation or some combination of diesel and steam. Still others will find it cheaper to purchase all or part of the power supply. No one solution is best for all plants. One thing, however, is sure. Practically all such plants have profits waiting the picking. All that is required is an open-minded and intelligent study of the possibilities.

For cost data and other essential information used in the preparation of this article the author is greatly indebted to C. W. Whiting, the consulting engineer, and to William E. Templeton, chief engineer of the Thomas G. Plant Corporation.

...RIGHT OUT OF THE PLANT...

How Vacuum Gage Is Protected Against Damage by Pressure

THE ILLUSTRATION shows how I protected a vacuum recording gage after it had been wrecked by exhaust pressure because of a float's sticking open in a deäerating heater. The end of the pipe leading to the



Vacuum gage connection with pressure relief

gage is plugged and a $\frac{1}{16}$-in. hole is drilled in the plug. This decreases the effect of any pressure surge in the pipe. To provide a relief for any pressure that may get into the pipe, and at the same time make the line air-tight under a vacuum, an elbow having a ball check on the outer end is attached at the other end of the tee. The ball is inclosed by a cap with relief holes drilled in the side, as shown.

EDWARD B. BACK.

Jeannette, Pa.

Operation of Hydro-Electric Units as Synchronous Condensers

THE ARTICLE by S. Logan Kerr in the Oct. 28 number on "Automatic Operator Controls Hydro Plant Economy" was of much interest to me. It calls to mind the similar operation that is taking place in Germany and elsewhere at the present time of units as synchronous condensers that would otherwise be lying idle.

Tests were carried out by Voith of Heidenheim, Germany, and the results went to show that with the spiral casing empty of water, and the runner rotating in air, the magnitude of the losses in the turbine was around 0.5 per cent of the full-load power. They found that in many cases it was possible to run with clearances of 0.75 mm. (0.029 in.) on the radius and still not heat the air, but that when the bearing nearest the runner became worn there was a danger of rubbing, and therefore a water spray around the clearances might be advisable.

It would be of much interest to know what American practice has shown to be best? It would also be of much interest to know how the casing is emptied? At an automatic station at Heidecke, near Cologne, where there are four units of 48,000 hp., the operation is done by connections to the tail water from the casing and draft tube by means of automatic valves operated by oil pressure from the governor. At Bringhausen, near Berlin, however, the tail water is above the turbine center line, and there compressed air has been resorted to.

London, England. H. A. SIEVEKING.

Suggested Use for Pulverized Coal Ash

IN THE majority of pulverized-coal installations large percentages of the ash pass out of the chimneys. This ash is distributed for miles over the surrounding territory. As many of the plants are located in thickly populated sections, the ash constitutes a serious nuisance. It is objectionable from three standpoints, namely: health, cleanliness and corrosion.

A number of contrivances, differing in design and operation, can be secured for catching the ash. Sometimes, because of space limitations, it is difficult to make a satisfactory installation in an old plant. It is safe to say that all new plants are likely to be equipped with some means for separating the ash from the flue gases.

After the ash has been caught it is a problem to dispose of it. Fine ash does not store readily, as the first windstorm will spread it over adjacent territory. If a suitable salvage value could be found, the expense of collection could be justified and the trouble of disposal eliminated. The following uses are offered in the way of suggestions:

1. Silica and limestone, ground so that 60 to 75 per cent will pass through a 200-mesh screen, are used to mix with asphalt in street work. Pulverized-coal ash, in some cases, could be used as a substitute. It is necessary

to use a good grade of coal, low in sulphur, with a high-fusing ash. With proper grinding and good combustion it should be possible to secure an ash low in carbon and sulphur and of uniform fineness. The ash will have to be packed in 100-lb. bags, and, as the business is seasonal, the bags stored during the winter. Pulverized silica sand in bags sells for about $5 per ton for this purpose. The price will vary in different localities.

2. Pulverized limestone and silica are used as an admix in concrete. They fill the small voids, thus making the concrete waterproof and increasing the compressive strength. Some specifications call for unusually fine grinding, so that if pulverized-coal ash is substituted, it probably will be necessary to repulverize the ash. This material in bags sells as high as $12 per ton.

3. Preliminary laboratory tests indicate that the addition of fine ash to concrete increases the plasticity and cohesion and retards the set. If this proves to be true it will increase the radius of distribution on concrete from central mixing plants.

4. Pulverized-coal ash can be used as a filler in certain paints.

5. Mixed with powdered soap, pulverized-coal ash can be used as a cleanser.

6. Certain ash consisting largely of silica and alumina has refractory properties, and, when mixed with silcate of soda, can be used for facing and patching furnace interiors.

7. Finely ground shale and limestone is spread around the workings of coal mines. The fineness should be such that at least 50 per cent will pass through a 200-mesh screen, and the inert content, in order to prevent flame propagation after an explosion, should be at least 60 per cent of the coal-dust mixture. Pulverized-coal ash should accomplish equally good results. Where the ash runs high in silica there may be some objection from a health standpoint, although this could be obviated by the use of masks.

F. J. McDevitt,
Baumes-McDevitt Company.
St. Louis, Mo.

How to Lay Up a Steam Turbine

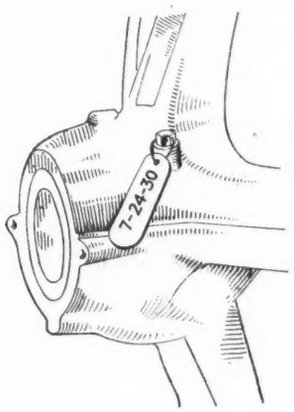
IN THE answers to a question that appeared some time ago in *Power* on "How to Lay Up a Steam Turbine," the readers were advised to pour oil into the turbine while it slowly turned over when about to lay it up. I assume that a condenser would be situated below the turbine, in which event the oil would be driven into the bottom of the condenser. In such a case the obvious course would be to remove a hand or inspection plate to give a constant drain for the condensate which forms under varying atmospheric conditions when the turbine is out.

May I refer to the turbine equipment of the Cunard liner Mauretania, which is, as it were, "laid up" at the end of each voyage for a few days. The procedure followed there was, in my time, to remove a blank flange at the base of the low-pressure turbine to obviate the collection of condensate after the turbine had been allowed to cool down. Obviously, care has to be taken that this flange is replaced before turbine is put into operation, particular attention being paid to the joint to insure no loss of vacuum at this point.

L. W. Ross.
Toronto, Ont.

Convenient Method of Recording When Bearings Are Lubricated

THERE are many ways of keeping a record of the oiling and greasing of motors and miscellaneous bearings, but I have found the following to be the handiest. One of the bolts or cap screws that



A strip of tin is stamped with the figures corresponding to the date of oiling and attached to the bearing bolt

holds the end bell or bearing cage is drilled through the head to take a small wire. A strip of tin is stamped with the figures corresponding to the date of greasing or oiling and wired to the bolt as shown in the illustration. No marking up of walls with chalk is necessary, and it can be read at a glance.

Thomas C. Hulton.
Abras Grandes, Cuba.

Oiled Commutator Upsets Parallel Operation

TWO direct-current generators operating in parallel were extremely "touchy" apparently for no reason. After carrying the load for some time, they started to spark, one machine tending to take all the load. The compounding of the machines was correct. Consequently, the performance of the two machines presented somewhat of a mystery. It was noticed, however, that one of the machines had a good chocolate-colored commutator. It was also discovered that the trouble began when the commutator that was not in such good condition was oiled by the operator.

Closer inspection revealed that one machine was carrying the heavier load, and that the voltage drop through the brushes, plus the lower contact resistance due to the absence of oil, caused a lower voltage drop, as a result of which the machine giving trouble tended to grab more than its share of load. Incidentally, it is well to bear in mind that carbon brushes have a negative resistance coefficient, the resistance decreasing as the temperature of the brushes increases, so that the brush resistance of the machine carrying the heavier load will be lower than that of the machine with the lighter load, hence the voltage drop will be less for a given load.

The situation was made more extreme by the fact that the machine carrying the lighter load and having the lower temperature of armature, yet highest voltage drop through it, was so located that a relatively cool draft

played upon its commutator; while the machine carrying the heavier load, with the hotter commutator and brushes, was located where there was relatively little draft, hence the rate of heat dissipation was lower. Oiling the commutator of the more lightly loaded machine increased the resistance at the brushes and so shunted a still greater portion of the load on the already overloaded and hotter machine.

The situation was remedied by shifting the brushes on the cool machine so that they would spark slightly, with the result of not only heating the commutator but also increasing the temperature of the brushes, in this way reducing their resistance. At the same time, a blast of cool air was directed upon the commutator of the overloaded machine, helping to bring down its temperature. As a result of these rather novel and out-of-the-way remedies parallel operation was thereafter maintained satisfactorily.

R. K. LONG.

Chicago, Ill.

Comparison of Pulverized Coal and Stokers

IN THE article by Samuel M. Greene in the Nov. 4 number entitled "Comparison of Pulverized Coal and Stokers" the statement is made that an accident to a stoker would shut the boiler down. That would depend much on the nature of the accident. We have been operating with only one 6,000-sq.ft. boiler fired by a seven-retort underfeed stoker for the past fifteen years, and we have never had a forced shutdown because of stoker trouble. The plant has run night and day always, and sometimes part of it Sundays. The boiler has been operated at about 200 per cent of normal rating. As an underfeed stoker carries quite a heavy fire, it can be stopped for a short time to make minor repairs without any considerable drop in steam pressure.

W. T. LAKIN, *Chief Engineer,*

Lowell, Mass. Lowell Bleachery.

Easy Method of Replacing Condenser Tubes

REPLACEMENT of condenser tubes that are badly worn is a rather slow and tedious job and some of them are likely to tear apart in the center plate; when this happens the holes in the outer tube heads must be plugged, as it is virtually impossible to get the pieces out and new tubes in, especially if time is limited.

To overcome this trouble we use a rod two feet longer than the tube and one that is a sliding fit inside the tube bore. The ferrules are removed, the packing cut out, and the tube driven out with a tool the same size as the tube but hollowed out to fit over the rod.

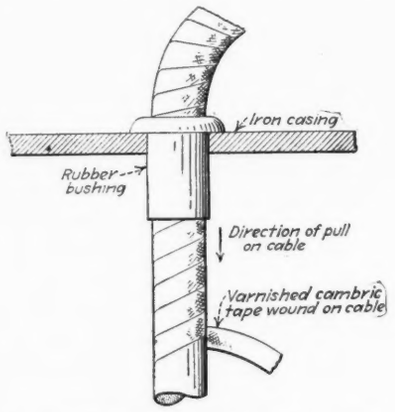
When the tube has been driven out far enough to obtain a good grip at the other end, it pulls out easily. Then a new tube is led on to the rod and placed in position.

With this method it takes only five to ten minutes to change a tube, and there is no danger of the tube's buckling or breaking at the center.

Holyoke, Mass. JOHN WINTERBOTTOM.

Pulling Cables Through Rubber Bushings

SOMETIMES rubber bushings are substituted for porcelain. Where this is done considerable trouble may be experienced in pulling the cables through the rubber bushings. This trouble can be eliminated by



Tape wound on cable to facilitate pulling of cable through bushing

winding on one layer of varnished cambric tape, the direction of overlapping being made with regard to the direction of pull of the cable. The use of grease should be avoided, as it is a factor in hastening the deterioration of the cable insulation.

Butte, Mont. RALPH E. MACKAY.

Environment Influences Plant Operators

I HAVE READ the article by A. J. Dixon on "Environment Influences Plant Operators," in the Nov. 4 number, and his remarks about the man on the night shift causes one to ask the question, "Should any man be left on the night shift year after year? Or the afternoon shift either?" I wonder how many readers of Mr. Dixon's letters have any idea of what it means to a man to work from 3 to 11 p. m. every day of the week, especially in a small plant in a small town.

The wonder of it to me is that they do not become more warped and narrow than is generally the case. In the first place, a man on such a shift is cut off from all social functions and community gatherings. Furthermore, for five days out of each week he sees little of his family.

Space permitting, I could name 101 reasons for not keeping a man on either the afternoon or night shifts without a change now and then; but the point that has me guessing is how any man who is broad enough to hold an executive position can fail to see the disadvantages of such an arrangement to both the man and the plant.

S. LEWIS.

Green River, Wyo.

✦

IN SOLDERING large size lugs with blow-pot, excess soldering paste tends to run over the surface of the metal and becomes troublesome. One of the best ways to overcome this difficulty is to use a clean cotton rag wound on a stick as a swab. It will be found that the rag takes up all the paste and leaves the surface of the metal clean.

Eliminating Sulphur Fumes At Battersea Station

British Minister of Transport predicts complete success for installation designed to eliminate sulphur fumes in the stack gases of the new Battersea station of the London Power Company. After a careful examination of the plan by experts he states that the liquid effluent of the treating plant can be rendered harmless for admission to the Thames River.

THE STACK NUISANCE problem—in its three-fold aspect of ash dust, smoke and sulphur fumes—is a matter of pressing national importance in Great Britain, as well as in the United States. London, particularly, is deeply concerned about its smoke problem.

In this connection *Power* has already reviewed (Nov. 4, 1930) the situation as it has affected the London Power Company. Permission to erect the new Battersea station on the Thames River was made contingent upon adoption of the best known methods of eliminating the stack nuisance.

Experimental work was set up at the London Power Company's Grove Road power station. First a small experimental plant was constructed consisting of a tower wherein the flue gases in counterflow could pass through water sprays. Arrangements were made for varying the amount and temperature of the water.

Basing the design upon the conclusions obtained from these tests, a full-sized gas-washing plant was installed at the Grove Road station. Drawings of this installation are shown in Fig. 1, which (along with Fig. 2) is based on drawings published in November as part of a report "Presented by the Minister of Transport to Parliament by Command of His Majesty." This was the second report of the advisers to the London Power Company, and was published with that of the committee presided over by the government chemist.

Of particular interest is the following introductory note:

> In authorizing the publication of these reports the Minister of Transport has ascertained from the committee presided over by the government chemist:
>
> 1. That the committee are satisfied from the experiments made at the Grove Road station of the London Power Company that it is practicable to install, in connection with the first section of the Battersea station, a plant which will reduce the emission of sulphur fumes to a negligible quantity.
>
> 2. That the committee are satisfied that, if such a plant is installed at Battersea, it will be practicable to treat the liquid effluent so that it may be admitted into the river.
>
> The committee point out that it would be for the Port of London Authority . . . to see that the necessary measures are taken.

Following (slightly abridged) is the so-called "Second Report of the Advisers to the London Power Company." The White Paper therein mentioned has not been abstracted in *Power*, but the main technical facts presented are covered in Dr. Pearce's paper abstracted Nov. 4.

"This report deals with the investigations that have been carried out by the London Power Company at the Grove Road power station since the date of the issue by the Ministry of Transport of the White Paper (Cmd. 3443) entitled 'Treatment of Sulphur Fumes in Connection With the Working

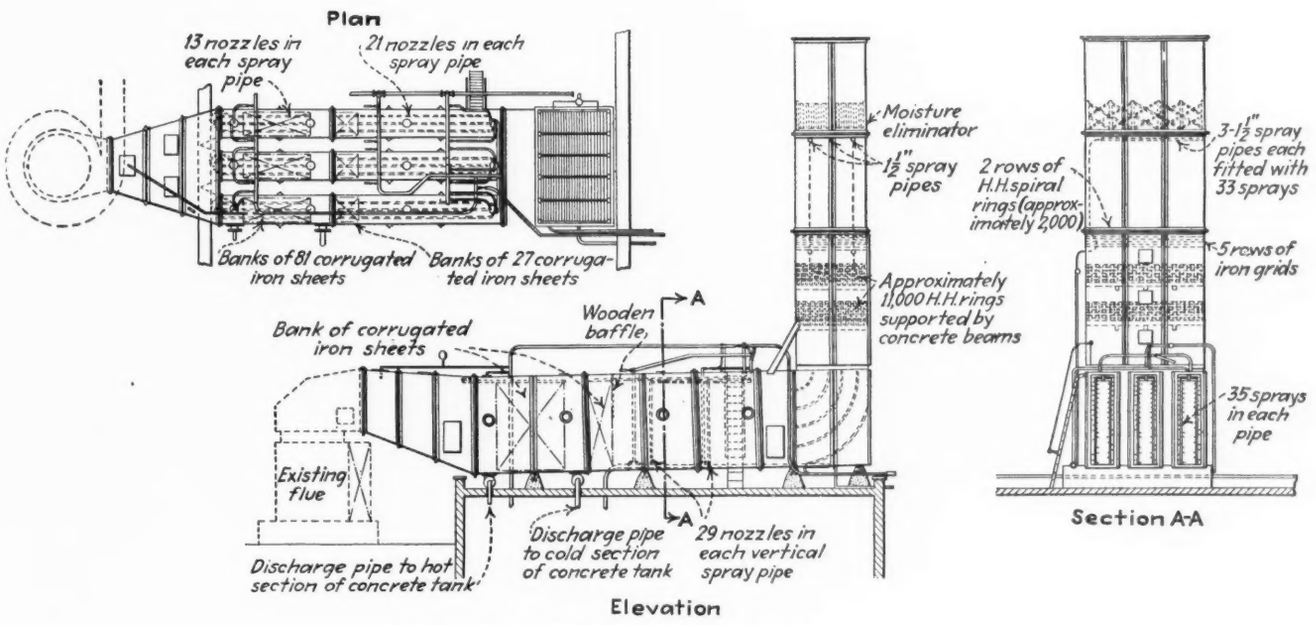

Plan
13 nozzles in each spray pipe
21 nozzles in each spray pipe
Banks of 81 corrugated iron sheets
Banks of 27 corrugated iron sheets
Moisture eliminator
1½" spray pipes
2 rows of H.H. spiral rings (approximately 2,000)
3-1½" spray pipes each fitted with 33 sprays
5 rows of iron grids
Approximately 11,000 H.H. rings supported by concrete beams
Wooden baffle
A
Bank of corrugated iron sheets
Existing flue
Discharge pipe to hot section of concrete tank
Discharge pipe to cold section of concrete tank
29 nozzles in each vertical spray pipe
35 sprays in each pipe
Elevation
Section A-A

Fig. 1—Gas-washing plant at the Grove Road station

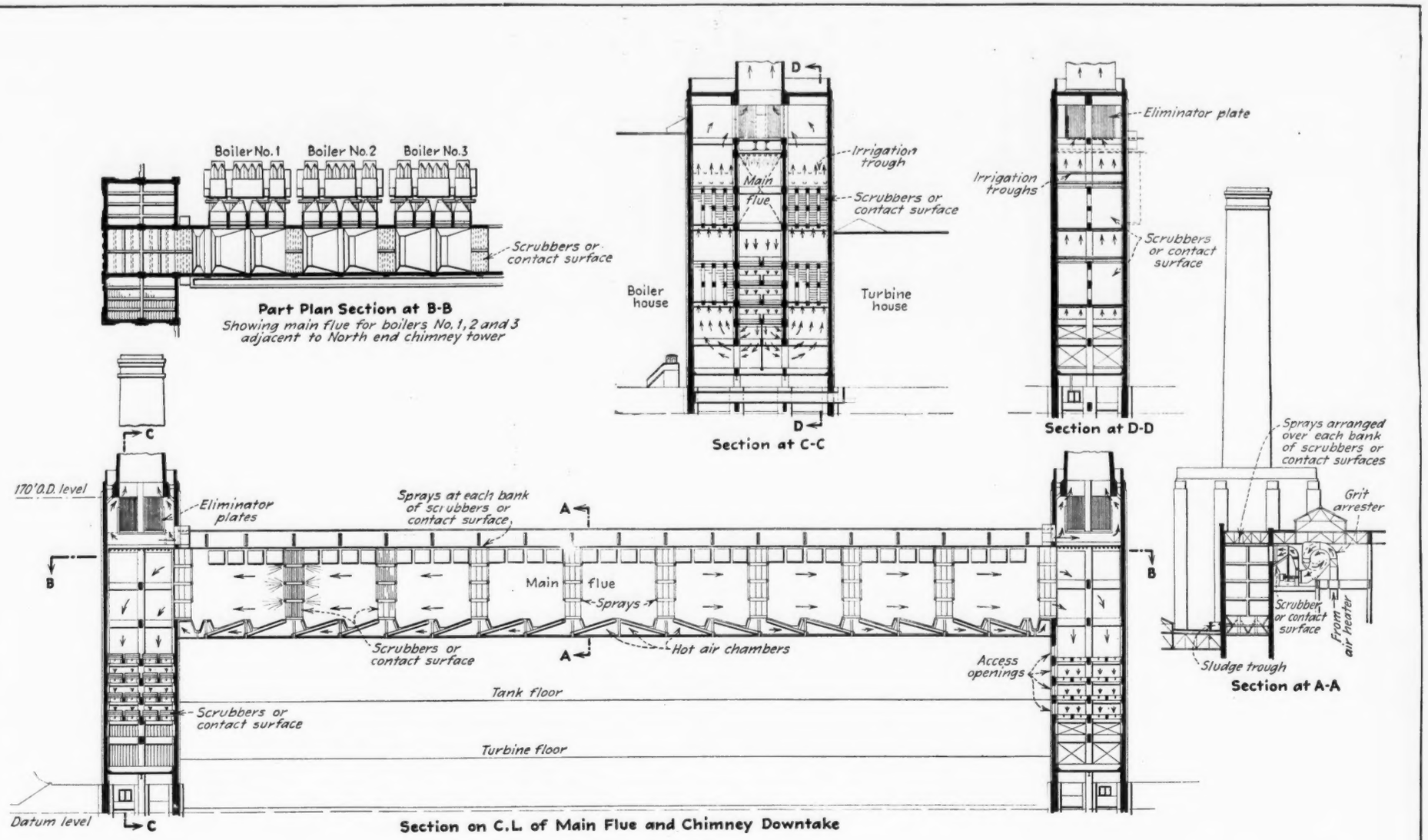


Fig. 2—General arrangement of main flue and towers in the gas-washing plant to be installed in the Battersea station of the London Power Company

of the Proposed Electric Power Station of the London Power Company at Battersea.'

"This large-scale plant—working in connection with boilers in daily operation—was not erected as a result of the experiments described in the White Paper, but had been designed and constructed independently before the former results were known.

"Prior to entering the gas-washing plant, the flue gases were passed through a grit arrester of the cyclone type. Afterward they passed through three horizontal channels arranged in parallel, the length of each channel being 34 ft. by 9 ft. 9 in. high x 2 ft. 9 in. wide [see Fig. 1]. Subsequently, the gases were collected and passed through a vertical tower 12 ft. x 7 ft. 6 in. in cross-section, and 34 ft. high. This vertical tower contained a filling of pottery rings, the depth of which was 4 ft., this material being sprayed with water, whilst the gas in its passage through the horizontal chambers was also sprayed with water.

"Operating in this manner, the percentage elimination of sulphur from the gases was about 20 at varying boiler loads, the quantities of water used ranging from 12 to 40 tons per ton of coal burned.

"To test the effect of iron, the first 11 ft. of each of the horizontal chambers was then filled with corrugated iron sheets spaced 1 in. apart and extending from the floor to the ceiling. Sprays were arranged in the ceiling so as to deliver water over the surface of the sheets.

"When using iron sheets, the remaining part of the horizontal chambers was sprayed with water, as in the previously mentioned case, and the pottery rings in the tower were flushed with water, as before.

"The results of the experiments carried out in this manner are given in the accompanying table. From these it will be seen that with full boiler load the elimination increased to 44 per cent (instead of 20 per cent without iron) and that when the boiler was working on half load an elimination of 67 per cent was obtained.

"It will also be seen from the table that when the boiler was operated at half load, and a solution of carbonate of soda was circulated through the vertical tower, an elimination of 97 per cent was obtained.

"It may be further mentioned that when the boiler was operating at about one-third load, the elimination of sulphur reached a figure of 75 per cent, without the use of anything except water in the vertical tower.

"We feel convinced that with an ample capacity in the gas-washing plant—as will be the case at Battersea [see Fig. 2] —affording thus a sufficient time of contact, and with iron as a catalyst, the elimination of sulphur from the gases, without the use of soda or other alkali, should reach 80 to 85 per cent at least. We think, therefore, that relatively little alkali will be required in actual practice to complete the total elimination of the sulphur, although provision has been made in the design of the Battersea plant for such treatment.

"A point of importance concerns the composition of the effluent. It will be seen from the figures given in the table that there remains in the effluent liquid a certain proportion of sulphite which it will be necessary to convert into sulphate. Since in the working plant at Battersea it will be necessary to have settling tanks to remove dust and grit collected in the effluent, there will be opportunity for the complete conversion of sulphite to sulphate, and precipitation of the iron as hydrate.

"On the question of cost, we have received from Dr. Pearce, the engineer-in-chief to the London Power Company, Ltd., his estimates of the capital and operating costs incidental to the application to the Battersea power station of the proposed gas-washing plant and system.

"On these estimates we consider the system to be a commercially practicable one in its application to the Battersea Station."

TABLE OF RESULTS AT GROVE ROAD

	Full Load	Half Load	Half Load and Alkali
Coal			
Lb. per hour	8,630	4,690	4,330
Carbon, per cent	63.2	65.9	65.8
Sulphur, per cent	0.90	0.89	0.84
Gas			
Cu.ft. per ton coal @ 60 deg. F.	375,000	490,000	485,000
Average CO_2 content of inlet gas, per cent	11.3	8.9	9.1
Temperature of inlet gas, deg. F.	229	231	225
Temperature of outlet gas, deg. F.	75	83	96
Cu.ft. per hour @ average temperature of 152 deg. F., 157 deg. F., and 160 deg. F., respectively	1,690,400	1,206,400	1,107,600
Inlet gas, SO_2, m.gm. per litre N.T.P.	0.90	0.57	0.93
Inlet gas, SO_3, m.gm. per litre N.T.P.	0.90	0.68	0.49
Total S, m.gm. per litre N.T.P.	0.81	0.56	0.665
Total S, grains per cu.ft. N.T.P.	0.354	0.245	0.29
Outlet gas, SO_2 m.gm. per litre N.T.P.	0.43	0.13	0.019
Outlet gas, SO_3 m.gm. per litre N.T.P.	0.59	0.31	0.026
Total S, m.gm. per litre N.T.P.	0.451	0.185	0.02
Total S, grains per cu.ft. N.T.P.	0.197	0.081	0.009
Per cent removed SO_2	52	77	98
Per cent removed SO_3	35	54	96
Total S	44	67	97
Water and Effluent			plus*13½ Alkali
Tons per ton of coal	27	50	
Gal. per hr.	23,100	23,100	5,845
SO_2, gr. per gal.	13.4	6.0	28.4
SO_3, gr. per gal.	8.0	14.3	42.1
Total S, gr. per gal.	9.9	8.7	31.0
(or parts per 100,000)	14.1	12.4	44.3
Total Fe, gr. per gal.	2.5	1.7	8.9
(or parts per 100,000)	3.6	2.4	12.7
Sulphur Balance Sheet.			
	Lb.	Lb.	Lb.
Coal S. per hour	77.6	41.7	36.4
Inlet gas per hour	73.0	36.0	38.8
Outlet gas per hour	41.2	11.9	1.2
Effluent, per hour	32.6	28.7	39.2
Ash, per hour	2.15	0.7	0.7
Column 3, in addition to the water used, alkali was recirculated at the rate of 300 gal. per hr. and contained:			
S, grains per gallon 305	.....	.....	13.1
These figures are included in the above balance sheet			
Time of Passage of Gas in Free Space in Seconds			
Horizontal, 1st section 11 ft.	2	3	3
Horizontal, 2d section, 23 ft.	4	6	6
Vertical (effective), 15 ft.	2½	4	4

*The smaller quantity of water is explained by the use of increased contact surface.

"We have now read the second report of the advisers to the London Power Company. In addition, a representative of the government laboratory, on April 8, 1930, visited the Grove Road installation while an experiment was in progress and made some chemical determinations. Further, on June 30, 1930, we visited the plant at Grove Road and had a discussion on the second report with Dr. Pearce, his advisers and staff.

"We are satisfied in the first place that the elimination of sulphur gases at the exit in these experiments was nearly complete, and this was confirmed by the observations of the chemist from the government laboratory mentioned above, who at the same time found that about half the burden of removal was borne by the sodium-carbonate wash. The protecting lining was not contributing to the neutralization of acid, and was in fair condition, a matter of less moment now when we are informed that acid-proof bricks are to be used at Battersea. We were informed that the excessive cost of soda ash for neutralizing residual sulphur gases will not be incurred, as it is proposed to use milk of lime, which is considerably cheaper, and that the sludge of dust, lime salts, including calcium sulphite and iron oxides would be removed from settling tanks and not discharged into the Thames.

"We note that it is now recognized that the conversion to sulphate obtained in the first report was due to the catalytic action of iron, but we are not clear that any marked advance in the process as such has been made, beyond the results reported there. In the present experiments the degree of catalytic conversion of sulphurous to sulphuric acid is comparatively small, the elimination of the sulphur acids being mostly by solution or neutralization by alkali.

"Generally, we may say that the company has achieved the object of eliminating sulphur gases from the flue gases on a fairly large scale, but we think the process used is capable of improvement in several directions, including cost.

"We recommend that the Ministry be given access to the records of the chemist supervising the working of the plant."

CREEP must be considered In Plant Design

A paper of great penetration and practical importance was presented last month by K. Baumann before the Institution of Mechanical Engineers (Great Britain), Northwestern branch. One portion, dealing with the multiple-superheater boiler, was reprinted in Power last week. The accompanying material is a brief digest of Mr. Baumann's study of the effects of «creep» on the design and operation of plants

DURING the last ten years investigations on the creep of steel at high temperatures have forced designers to the conclusion that the old methods of stress analysis are wrong in principle, because they are based on Hooke's law, that is, on the proportionality of strain and stress. Experience has shown that Hooke's law does not hold at high temperatures.

Steel, when submitted to stress at high temperatures, continues to expand very slowly beyond the initial elastic extension, which occurs as soon as load is applied. This slow and continuous extension, called creep, increases with the stress and temperature to which the material is subjected. If the stresses are not uniformly distributed throughout the structural element, immediately load is applied, the more highly stressed parts will creep at a greater rate, and in time the material will be more uniformly stressed, provided the stresses are still above the true creep limit.

Recent experiments have fully justified the suggestion made a few years ago by R. W. Bailey that a creep limit in fact does not exist. It follows, therefore, that it is only a question of the actual time required to enable the stresses and machine elements to become more uniform under given normal operating conditions.

The creep limit has been arbitrarily defined as that in which the stresses produce a creep equal to 10^{-6} times the actual length per hour. However, certain parts, such as bolts for flanges, if stressed to this limit, would cause considerable difficulty, due to steam leakage, etc., after a relatively short time.

Recommended Creep Limits

It can be shown, for example, that if bolts are to remain tight for two years the elastic strain creep time must be, roughly, 20,000 hr., corresponding to a creep rate of 10^{-5}. The same limits apply to the turbine cylinder itself, if the condition has to be met that the cylinder should not increase in diameter more than 0.001 in. per inch in ten years.

For parts that depend upon shrink fits for their satisfactory operation, and which are not subject to adjustment, such as turbine disks shrunk on shafts, an even lower limit for creep rate must be provided for, that is, a creep rate of the order for 10^{-9}.

For parts that are not riveted or bolted, but jointed by welding, for instance, or for parts which have no such joints, as in the piping itself, higher creep rates are permissible, provided a change in size or shape does not affect the safety or operation of the plant.

It would seem permissible to design steam piping (apart from bolted flanges) for a creep of 10^{-7} per hour, which would mean, roughly, that the diameter of the pipe would increase 1 per cent in ten years. The same creep rate could also be admitted for water tubes in boilers.

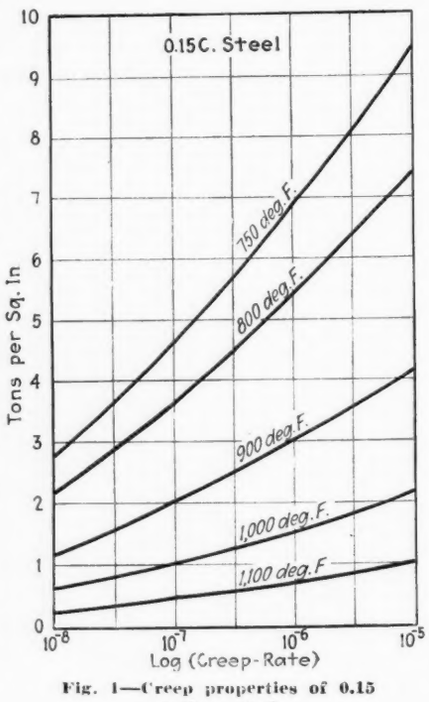


Fig. 1—Creep properties of 0.15 carbon steel

For superheater tubes, creep rates of 10^{-6} should be permissible, or an increase in diameter of 10 per cent in ten years. For some of the more exposed parts of a superheater, even 10^{-5} per hour may be permissible, provided these parts are easily replaced.

These creep rates are, of course, dependent on the further condition that the stresses be well below the yield point of the material at the particular temperature. A factor of safety of 3 relative to this yield point, or a factor of 2 relative to the limit of proportionality, is at least required.

Development of high-temperature plants is seriously handicapped by lack of information available with regard to the creep properties of material suitable for high temperatures. Short-time tests for ultimate tensile strength are relatively easily carried out, but, unfortunately, they provide no criterion of the suitability of the material for high temperatures, because the test result depends upon the rate of extension applied during the test, and this is usually not specified or controlled.

Until much more information, particularly for lower rates of creep, is available, the curves here presented should be regarded only as an intelligent anticipation of the creep properties. But it is probable that these will not differ greatly from the figures given.

Creep Properties of Steel

In Figs. 1 and 2 the stresses for different temperatures are plotted against the logarithms of the creep rate. These curves show the rapid decrease in creep strength with higher temperatures, and the continued creep at very low stresses.

Stresses in pipe subjected to high internal pressures have usually been calculated on the basis of Hooke's law, but this has been shown to provide a fallacious approach.

At temperatures above 900 deg. F. pipe must be calculated from consideration of the creep strength, unless creep rates higher than 10^{-7} are permissible. It is not necessary, however, to calculate the stresses at temperatures below 900 deg. F. on the basis of Hooke's law, as creep will still operate toward equalization of the stresses within a relatively short period. Creep will also be beneficial with regard to bending stresses resulting from pipe expansion.

It has been concluded by many authorities in the past that, on account of the great increase in stresses at the inner walls, an increase in the thickness of the walls and tubes beyond a certain limit was undesirable. Their conclusion was based on calculations of the stresses according to the elastic theory. The comparisons given may suffice to show that these conclusions do

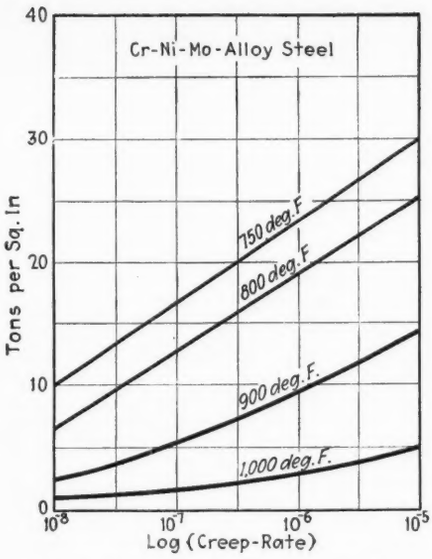


Fig. 2—Creep properties of Cr-Ni-Mo alloy steel

not apply when the material is subject to creep such as is bound to occur in boiler and superheater tubes.

Preventing Flange Joint Leaks

The question arises as to what conditions must be met to prevent leakage in flange joints. The bolts must be able to take the thrust due to steam pressure. It is usual to assume that this will be exerted on the diameter of the pipe, and the area of the joint surface. In addition, the bolts must produce a certain pressure over the joint surface, which must bear some relation to the steam pressure. It is doubtful whether the joints can be maintained with a pressure at the joints less than double the steam pressure.

The following three deductions from studies made of this problem merit special mention:

1. If the stress in the bolts, due to the steam thrust alone, produces creep of the order of 10^{-8}, it may be possible to keep the joints tight for approximately one year, but not longer, provided the flexibility of the flange is at least equal to that of the bolt, and provided the stresses in the flange do not produce creep.

2. Flexibility in the flange is very desirable, provided the stresses in the flange do not cause creep. A flange of which the flexibility equals that of the bolt compensates for a reduction in creep strength of the bolt of, roughly, 25 per cent, or, alternatively, doubles the life of the joint.

3. With a rigid flange, the life of the joint is independent of the length of the bolt, both creep and flexibility being increased in proportion with the length, and their individual effects are compensated. The use of a longer bolt is beneficial only if the addition of a washer, or the like, adds to the flexibility of the flange but does not add proportionately to the creep rate. In general, the life of a joint is increased by additional flexibility only if this additional flexibility does not involve a proportionate increase in the creep rate of the structure.

It has been suggested that it is beneficial to reduce the diameter of the shank of the bolt to the root diameter of the thread. In Fig. 3 curves A'_3 and B'_3 show the life of the joint with full bolts expressed as the ratio of this life to the life of a joint using undercut bolts (curves A^3 and B^3) for the same loading of the flange. On account of the decreased rate of creep of the full bolt, resulting from the lower stresses in the shank, the life of the joint is roughly doubled, which clearly proves that the practice sometimes suggested is erroneous.

If during normal operation the bolt and the flange are at the same temperatures, it follows that when cold the stresses will be the same as when under load, provided the coefficients of expansion of the material in both flange and bolts are the same. During warming-up the temperature in the bolts will not be raised as quickly as the temperature in the flange, with the result that both the bolt and the flange will be subjected to higher stresses. If the elastic limit is exceeded, the bolts, and possibly also the flanges, may be permanently stretched, and this may cause a leakage of the joints. As these stresses occur at temperatures lower than the normal, and as the starting-up periods are of short duration, the question of creep will not usually enter into consideration.

Decreased stresses in the joints, when cold, may be a source of difficulty, because, when the piping cools, additional bending stresses may occur unless the joints are located in those parts of the pipe line where bending stresses are small. These difficulties could be minimized if the coefficient of expansion of the bolt material was slightly higher than that of the material used for the flanges. From this point of view, it is apparent, therefore, that there is a definite limit to the difference in the temperature of the bolts and that of the flange.

In addition, a relatively large difference in these temperatures will also involve a correspondingly increased difference in temperature during starting up, as an unsatisfactory lagging of the joints would undoubtedly introduce greater temperature stresses than a perfect lagging, and this would produce stressing not only of the bolts, but also of the flange.

The flanges are subject to higher temperatures than the bolts. For this reason they are likely to creep to an extent that has probably not been sufficiently appreciated. Measurement of flange distortions is not easily carried out, and it is possible that they have escaped notice.

It is evident that flange joints for high pressures and temperatures have a limited life but that a new lease of life can be obtained by the simple process of tightening the bolts.

It is a matter for further investigation whether it would be better to submit new bolts, prior to their use in flanges, to stresses at the appropriate temperature, in order to pass them through the first stage of creep.

The conclusions which have been arrived here emphasize the urgent necessity for systematic investigation on the behavior of flange joints at high temperatures and pressures on a greater scale than has been contemplated hitherto.

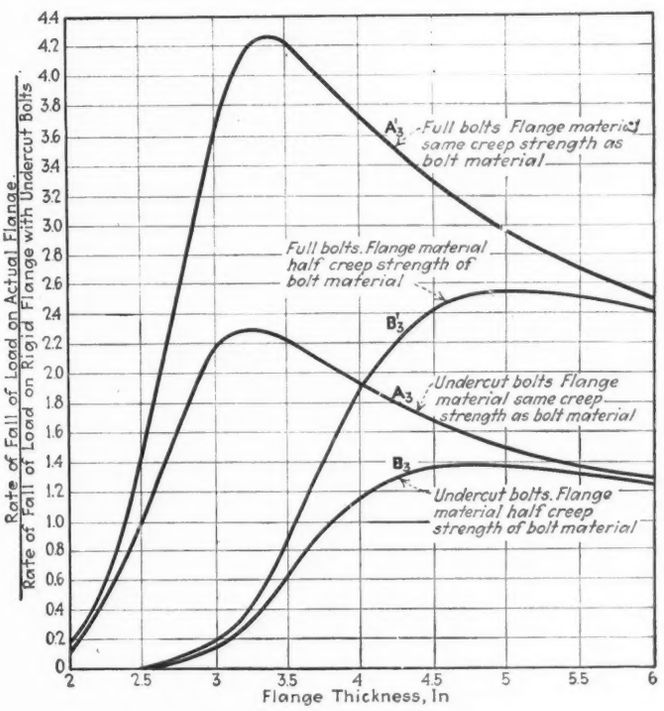

Rate of Fall of Load on Actual Flange
Rate of Fall of Load on Rigid Flange with Undercut Bolts
A'3 Full bolts Flange material same creep strength as bolt material
Full bolts. Flange material half creep strength of bolt material
B'3
A3 Undercut bolts Flange material same creep strength as bolt material
B3 Undercut bolts. Flange material half creep strength of bolt material
Flange Thickness, In

Fig. 3—Relative life of loose flanges showing comparison of full and undercut bolts

From Among Readers' Problems

Conducted by
L. H. MORRISON

OPERATING TWO BOILERS ON ONE STACK—*In our power house we have two stoker-fired 1,500 sq.ft. boilers. We operate these boilers alternately, each boiler running from one to two months each.*

Until recently each boiler had a stack 68 ft. high and 34 in. in diameter. One of the stacks broke in two, being practically eaten away about 16 ft. from the top. Before we could put a new one in its place the other stack fell.

We assume this condition was the result of allowing these stacks to become cold while not operating the boiler, permitting dampness to collect and combine with the sulphur in the stack to form sulphuric acid.

Can we operate both boilers on one stack? This will enable us to keep the stack warm when either boiler is operating. Would the one stack be capable of taking care of both boilers at one time if it were ever necessary to operate that way? E.M.

I can see no reason why the one stack should not be placed on a breeching connecting the two boilers. Of course, each boiler uptake must have a tight-fitting damper. I do not believe the one stack could care for both boilers if they were operated simultaneously at their rating, as the stack diameter is too small and no greater than needed for one boiler. A 42-in. stack would be advisable.

The excessive corrosion was undoubtedly the result of permitting the stack to cool, thereby causing the sulphurous gases to condense.

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FACTOR OF EVAPORATION WITH HIGH FEED TEMPERATURE—*Suppose 240-deg. water is being pumped into a boiler carrying 250-lb. gage pressure and having 150 deg. of superheat. How would one determine the factor of evaporation?* L.F.B.

The factor of evaporation is found in the same way, regardless of the feed-water temperature.

Taking the example cited: Feed water, 240 deg., boiler pressure 250 lb. gage, and with 150 deg. of superheat, the process is as follows: Steam at 250 lb. gage and 150 deg. superheat has had added to it 1,292.1 B.t.u., this being the total heat shown in the steam tables for this steam condition. Feed water at 24 deg. F. contains 208.3 B.t.u. The difference, 1,292.1 — 208.3 = 1,083.8 B.t.u., has been added by the fuel. As the evaporation of water at 212 deg. F. into steam at 212 deg. F. and 14.7 lb. abs. requires 970.4 B.t.u., the factor of evaporation is 1,083.8 ÷ 970.4 = 1.117. In other words, the heat used to evaporate one pound of water under the given conditions equals the heat required to evaporate 1.115 lb. of water at 212 deg. F. into steam at 212 deg. F.

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CLEARANCE OF OIL ENGINE PISTONS—*Will you tell me how I can determine within close limits the clearance in oil and gas engine cylinders, to keep the connecting rod the proper length or to measure up for a new rod and brasses.* H.H.

The actual clearance between the crown of the piston and the cylinder head of an oil or gas engine depends upon the compression pressure to be carried and upon the shape of the clearance space. For example, suppose that in an oil engine the clearance volume is to be 8 per cent of the piston stroke volume. If the valves are in the head, and the combustion chamber is of the same diameter as the cylinder, the piston must stop at a point equal to $\frac{8}{100}$ of its stroke, or for an 18-in. piston the distance from the head would be $\frac{8}{100} \times 18 = 1.44$ in. But if the valves are in side pockets and the same total volume must be maintained, the piston must come closer to the head.

Usually it is possible to adjust the shims of the rod end or boxes to give an approximate clearance. The real clearance must be determined by indicator diagrams, and shims must be added or removed to obtain the desired compression pressure, which depends upon the type of engine.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

IF IT IS DESIRED to burn the same amount of coal with natural draft, will the stack be the same height at sea level and at an elevation of 7,000 feet? D.C.

ASSUMING that a constant draft in inches of water produces a given rate of operation regardless of the altitude, the ordinary rule is that stack height be increased as the ratio of the barometric pressure at sea level to that at altitude, this ratio being usually expressed as R, and the stack diameter be increased as the 2/5 power of R.

To burn a constant weight of coal requires a constant weight of air. As the altitude increases, the density decreases, and a constant weight of air and gases must have increased velocities. The mean velocity for a given boiler burning a constant weight of coal will be inversely proportional to the barometer pressure or directly proportioned to ratio R^2, and the velocity head measured in a column of external air will be inversely proportional to the square of the barometric pressure, or directly proportional to the ratio R^2. This is on the assumption that the temperatures remain constant. The added frictional loss due to the added gas velocity and height is compensated by an increase in diameter, and with this reasoning the stack height correction should be R^2.

	Altitude, Ft.	Barometric Reading, In.	R	$R^{2/5}$
Kidwell	7,000	23.22	1.292	1.108
Steam	7,000	22.97	1.306	1.113
Marks Handbook	7,000	22.97	1.306	1.113
Worker and Peebles	7,000	.....	.....	1.11
Stoker Mfg. Assn.	7,000	.....	1.388	1.113

In the problem given, 7,000 ft. altitude, Kidwell says the stack diameter, and grate area as well, should be multiplied by 1.108 which is $R^{2/5}$, and rather prefers the value of 1.292 or R, for the stack height correction.

The Stoker Manufacturing Association recommends the values of $R^{2/5}$ for stack diameter correction and the value of R for stack height correction.

Steam says the stack diameter correction should be $R^{2/5}$ and the stack height correction R, but suggests a value be taken midway between R and R^2.

Worker and Peebles say the stack diameter correction should be 1.11 and the stack height correction should be 1.70.

Marks Handbook says the stack diameter correction should be $R^{2/5}$ and the stack height correction should be R^2.

It would appear that authorities are not in accord as to whether the stack height correction should be R or R^2. If at high altitudes the increase of stack height is such as to make the proportion of height to diameter impractical, or the increase of stack height necessary be such as to make the cost of chimney construction high, then some increase in the grate surface should be made, and the reduction of the combustion rate will reduce the draft required.

ABBOTT GLICK.

Sheboygan, Wis.

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THE WEIGHT of air required for burning a given amount of coal is the same at all altitudes, but air at high altitudes is under less pressure and therefore has less oxygen per cubic foot.

As the altitude increases, then, it is necessary to increase the velocity of the air in order to get the required weight of oxygen to burn a given amount of coal. The mean velocity will be inversely proportional to the barometric pressure, and the velocity head, measured in the external column of air, will be inversely proportional to the square of the barometric pressure. The increased frictional loss due to necessary increase in velocity of stack gases will have to be compensated for by increase in the diameter of the stack as the height above sea level increases. The necessary increase in diameter of stack is proportional to the two-fifths power of the ratio of the barometric pressures.

For an elevation of 7,000 ft. I should figure that the height of the stack would have to be increased one and seven-tenths times and the diameter should be one and one-eighth times as large as at sea level. CLAUDE E. ANDERSON.

Great Falls, Mont.

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AT 7,000 ft. the normal barometer will be 23 in. Hg., compared to 30 in. at sea level. The volume of gas for a given amount of fuel burned will be increased in the ratio of $\frac{30}{23} \times$ volume at sea level, or an increase of 30.5 per cent.

The friction loss through the grates, boiler tubes and breeching is proportional to the square of the gas velocity and inversely proportional to the density of the gas. The net result is an increase in friction loss of 30.5 per cent.

The draft at the base of the stack must be increased by 30.5 per cent to produce the required gas flow. Since the draft produced is the difference in weight of the gas column inside and outside the stack, due allowance being made for stack friction, the stack height must be increased 30.5 per cent to produce a draft at the base equal to that at sea level, and this height must be increased further by 30.5 per cent to take care of the increased friction losses through the boiler and grates.

Thus the stack height must be made $1.305 \times 1.305 = 1.70$ times the height at sea level, assuming the diameter is varied to keep the stack loss constant.

Wilmington, Del. C. S. COLLIER.

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THE REQUIREMENT to burn equal amounts of coal at sea level and at 7,000 ft. elevation virtually implies the consumption of equal weights of air.

At 7,000 ft. above sea level the normal barometer is 23 in. Hg., so that the volume of air to be handled at such altitude is 30/23 or 1.3 times as much as at sea level. This means that the gas velocity in the stack will have to be 1.3 times as much, and this is secured only by an increase in the stack height in proportion to the ratio of the squares of the velocities, or 1.70.

If at sea level the stack height required is 100 ft., at 7,000 ft. elevation it will be 170 ft.

The increased height of chimney and increased velocity of gases will increase the friction, tending to reduce the draft, and this will have to be taken care of by an increase in diameter. The increase will be proportional to the $\frac{2}{5}$ power of the ratio of barometric pressures, in this case approximately 1.11 times, so that a stack of 9 ft. diameter at sea level will have to be 10 ft. at the higher altitude of 7,000 ft.

J. F. GONZALEZ.

Guayama, P. R.

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A Question for Our Readers

WHAT is the maximum probable equivalent evaporation that one should expect from a plant containing three water-tube boilers totaling 10,000 sq.ft., when hand-fired with natural draft at 90 per cent rating, with a very high grade run-of-mine coal? What should be expected at 30 per cent rating during the 14-hr. night shift? How much could the efficiency and per cent rating be increased if stokers were installed? Two of the boilers are sixteen years old and the third is seven years old. M.H.C.

Suitable answers from readers will be paid for and published in the Feb. 3, 1931, number

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ASSUMING that the desire to burn the same amount of coal at an altitude of 7,000 ft. as at sea level disregards the difference in the boiling point of water at sea level and at altitude, the effect of altitude on the draft resistance of the boiler unit must be considered as well as the effect on the natural draft developed by the stack. At 7,000 ft. altitude the barometer is 23 in. referred to 30 in. at sea level, a ratio of 0.766. In other words, the weight of air at 7,000 ft. above sea level is 76.6 per cent of that at sea level. The effect of possible changes in atmospheric temperature at the two elevations will be ignored.

Inasmuch as the same weight of gas at a lower density must be handled at altitude as at sea level, the velocity must be increased by $\frac{1}{0.766}$, or 1.305. However, the draft loss varies as the product of the square of the velocity and the density. The density varies as the ratio of the barometric pressures. Hence, the draft loss at altitude is that at sea level divided by the ratio of the pressure at 7,000 ft. (23 in.) and that at sea level (30 in.), or 0.766.

The static draft that may be developed at altitude by the stack is decreased by the same ratio, or for the same draft the height is increased by the reciprocal of the ratio. Then, to handle the same weight of gas, the height required at sea level must be divided by the square of the ratio at altitude, or $(0.766)^2 = 0.587$. The reciprocal is 1.704. Therefore, to burn the same amount of coal with natural draft at 7,000 ft. elevation, the stack must be 70 per cent higher than at sea level. W. S. JOHNSTON.

Boston, Mass.

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TO BURN the same amount of coal with natural draft at various altitudes the same amount of oxygen must be supplied in the air per pound of coal. There is the same amount of oxygen per pound of air at higher altitudes, but not the same pounds of oxygen per cubic foot of air. In other words, the density is inversely proportional to the change in pressure. The barometer pressure at 7,000 ft. altitude is about 22.97 in. of mercury. The pressure would be $22.97 \times 0.491 = 11.3$ lb. per square inch absolute.

The assumptions are usually made that stack height varies inversely as the ratio of the air pressure at sea level, or in the case of 7,000 ft. altitude, the stack would be $14.7 \div 11.3 = 1.3$ times as high as at sea level to produce the same draft in inches of water at the base of the stack.

The above does not take into account the fact that when the stack is working at maximum capacity at any altitude the entire draft is used in overcoming the resistance of flow of air through the grates and flues of the boiler, which have a fixed area; therefore these resistances are proportional to the square

of the velocity head. To overcome furnace resistances, then, would require a chimney height of $\frac{(14.7)^2}{(11.3)} \times$ original height at sea level = 1.7 times the sea level height. The above computations disregard entirely the friction due to the added length of stack necessary, which is 70 per cent; but since the stack will probably not be working at maximum capacity at all times the furnace resistances will be lower; therefore the proper height of the stack would fall somewhere between 170 and 130 per cent of its height at sea level. The 170 per cent height would be well on the safe side for normal duty.

A. V. KILPATRICK.

Rolla, Mo.

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FOR ALL practical purposes it is sufficiently accurate to determine the height of a stack by the inverse ratio of the absolute air pressures.

For example: A stack at sea level 100 ft. high will produce the same draft as a stack 131 ft. high at an elevation of 7,000 ft. This height is determined as follows:

$$100 \text{ ft.} \times \frac{14.7 \text{ abs. pressure at sea level}}{11.2 \text{ abs. pressure at 7,000 ft. elev.}} = 131 \text{ ft.}$$

Of course, the diameter of the stack must be increased to prevent the increased pressure drop from exceeding the available draft.

The diameter should be increased as the inverse ratio of the $\frac{2}{5}$ths power of the barometric pressure. In the example given above, if the stack diameter at sea level were 10 ft. the stack diameter at 7,000 ft. elevation should be 11.13 ft.

$$10 \text{ ft.} \times \frac{(14.7)^{\frac{2}{5}}}{(11.2)^{\frac{2}{5}}} = 11.13 \text{ ft.}$$

J. M. TOTTEN.

Mount Vernon, N. Y.

—◆—

I ASSUME that the same equipment will be used and the same atmospheric temperatures prevail at sea level and at 7,000 ft. elevation.

The static draft of a stack of a given height is dependent upon the atmospheric pressure, the atmospheric temperature and the temperature and density of the stack gases.

Atmospheric pressure is customarily expressed in terms of inches of barometer reading. At sea level, under normal weather conditions, the barometer reads 29.92 in. (approximately 30 in.). The static draft for any other barometer reading will vary as $B/30$, in which B = the barometer reading. As the barometric pressure decreases with elevation the static draft also decreases, and to produce the same static draft at an elevation as at sea level the height of the stack must be increased. The ratio of increase is the static draft at sea level divided by $B/30$.

While the weight of the gases produced in burning the same amount of coal will be the same in both cases, the reduced atmospheric pressure will decrease the density of the gases at the higher elevation and their velocity must be higher to pass the same weight through the unit. The draft resistance of the fuel bed, boiler passes and flues increases at the higher elevation, and the draft loss will be the draft loss at sea level divided by $B/30$.

Since the height of the stack required to produce the same static draft at an elevation as at sea level is $\frac{1}{B/30}$ and the height must be still further increased in the ratio of $\frac{1}{B/30}$ to overcome the increased draft loss, the total height of the stack at an elevation will be the height of the stack at sea level divided by $(B/30)^2$.

The mean barometer reading at an elevation of 7,000 ft. above sea level is 23 in., so $B/30$ becomes $23/30$.

Therefore the height of a stack required to do the same work at 7,000 ft. elevation is $\frac{1}{(23/30)^2}$, or 1.7 times its sea-level height.

LLOYD R. LEATHERMAN.

Chicago, Ill.

—◆—

NORMAL barometer at sea level is 29.92 in., corresponding to an atmospheric pressure of 14.7 lb. per square inch. At 7,000 ft. altitude the normal barometer is 22.97 in., or the atmospheric pressure is 12.3 lb. per square inch. The stack at 7,000 ft. altitude would therefore have to be considerably higher than the one at sea level.

When the height of the stack is increased the friction of the gases moving upward in the stack is also increased; so in addition to increasing the height of the stack it would be necessary to increase its diameter.

The usual formula for computing draft intensities is:

$D = 0.52H \times P\,(1/T - 1T_1)$, where

D = Draft produced (inches of water).

H = Height of stack (grates to top of stack).

P = Atmospheric pressure (lb. sq.in.).

T = Absolute temperature of atmosphere (F 460 + deg. F.).

T_1 = Absolute temperature of flue gases.

Using this formula for a 100-ft. stack at sea level, temperature of atmosphere taken as 60 deg. F., and flue gas temperature of 500 deg. F., we have 0.674 in. draft. Substituting this value in the formula,

$0.674 = 0.52H \times 12.3\,(1/520 - 1/960)$.

or

H = 120 ft. = height of stack at 7,000 ft. altitude

As previously mentioned, it would also be necessary to increase the diameter or height of the stack to take care of the additional friction of the flue gases. This can be accomplished by substituting 0.42 instead of 0.52 in the last formula. This makes allowance for a reasonable number of bends and slight restrictions in the ducts connecting the boiler to the stack. These values could be determined accurately if desirable, and would change the value of 0.42 accordingly.

RALPH RAINEY.

Albuquerque, N. M.

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THE STACK will not be the same height at sea level and at an elevation of 7,000 ft. if it is desired to burn the same amount of coal with natural draft. Also the stack diameter will change.

Ordinarily it is assumed that the height of a stack for altitude will be increased inversely as the ratio of the barometric pressure at the altitude to that at sea level, and that the diameter of the stack will increase inversely as the $\frac{2}{5}$ power of this ratio. This relation has been based on the assumption that regardless of altitude the draft in inches of water measured at the base of the stack is constant for a given rate of operation of the boilers.

Assuming that boilers, flues, furnaces are the same and that the increased velocity of a given amount of air through a fuel bed and furnace at a higher altitude have no effect on combustion, the theory has been advanced that the stack height should be increased inversely as the square of the barometric pressures.

Certain tests have been made showing no difference in combustion rates for a given draft at high and low altitudes. This would indicate that the correct height to use is closer to the value obtained by using the inverse ratio of the barometric readings than by using the inverse ratio of the squares of the barometric readings.

EMIL A. NELSON.

Springfield, Ill.

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A STACK will need to be higher at an elevation of 7,000 ft. than at sea level. The draft in inches of water is less at high altitudes. This, however, is not the answer, since the velocity of gases through the boiler depends on the formula $V = \sqrt{2gh}$, in which V = velocity in feet per second, $g = 32.2$, and h = head in feet of flowing gas or liquid. It follows that the same plant at sea level or high altitude would have the same velocity of gases through the system. At high altitudes, however, the volume of gas will be increased, for the same amount of fuel, in inverse ratio of the barometric pressures due to the decrease in density. The stack and breeching can be increased in area to care for the added volume. If the boiler and fuel bed passages could be correspondingly increased, the same height of stack would serve in both cases. The velocity remaining the same, all that is necessary is to provide area to get the same weight of air through the system.

It is impractical, however, to increase the size of boiler passages; so the usual method is to increase the size of the breeching and stack and add enough to the height to care for the added resistance through the boiler and fuel bed.

RUSSELL S. CLARK.

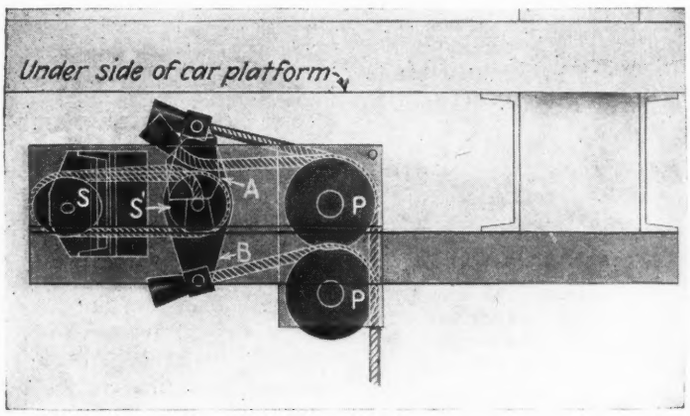
Barberton, Ohio.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Equalizer for Elevator Compensating Ropes

FOR several years automatic equalizers have been in use on the hoisting ropes to compensate for the causes of unequal tension and to distribute the load between the individual ropes in the group. It is now recognized that short life and other unsatisfactory operations of compensating ropes are due to causes similar to those resulting in short life of hoisting ropes. To overcome these difficulties the Evans Elevator Equalizer Company, 122 East 42d St., New York City, has developed an improved type of automatic equalizer for the compensating ropes. The first type of equalizer used for this purpose was similar to that applied to the hoisting ropes. Although it equalized the loading on the compensating ropes, it was not suited for installing in the limited space under some cars.



Compensating-rope equalizer installed under an elevator car

Instead of hanging vertically as did the earlier type, the new equalizer is installed horizontally, as in the figure. The type shown is for five compensating ropes. The ropes come from the compensating sheave up over five sheaves P on the equalizer. Three ropes come on top and two below, each on its own sheave to allow for free movement. The sheaves P all line up in a vertical plane to maintain the ropes in the same plane and reduce to a minimum possibility of their being fouled by objects falling in the hoistway.

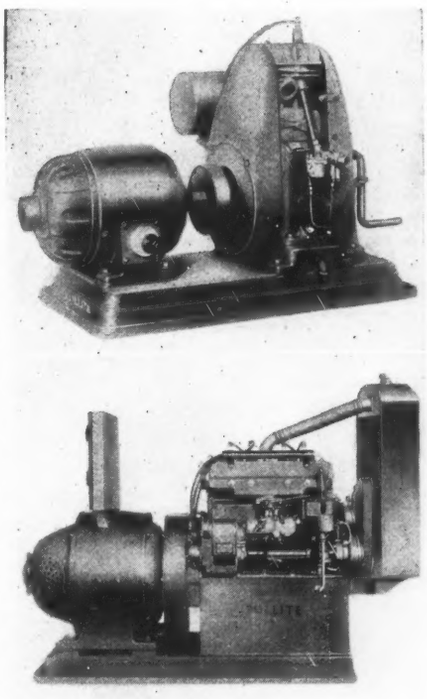
Four of the ropes connect to the ends of two equalizing bars B. Each of the bars is free to move about its axis, and is attached to a sheave. The fifth rope is attached to one end of the equalizing cable, as at A. From this connection the equalizing rope passes over a stationary sheave S in the equalizer, then over a sheave S' on one of the equalizing bars, around another stationary sheave S and over the sheave on the other equalizing bar and back to the rear of the equalizer, where it is deadended. From this hook-up it is evident that the ropes are free to distribute the load equally between them.

When six compensating ropes are used, the equalizer is arranged with three equalizing bars, each group of two ropes connecting to the ends of a bar. In this case both ends of the equalizing rope are deadended, otherwise the rope loops around the stationary sheaves and the sheaves on the equalizing bars in the same way as for the five-cable type.

Portable, Self-Contained Electric Lighting Plants

THE accompanying illustration shows two of a number of models of "Sullite" electric lighting plants now being offered by the Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Made in a number of sizes ranging in capacities from 350 watts to 15 kw., the units are completely self-contained and operate without the use of a storage battery or other accessory. In addition to supplying illumination, they can be used to power motor-driven tools and other equipment within the capacity range of the generator.

In the unit shown in the upper view, a 110-volt 750-watt generator is connected through a flexible coupling to a single-cylinder, four-cycle, air-cooled engine equipped with a high-tension magneto. Double cooling blowers are provided to assure proper cooling of the engine in



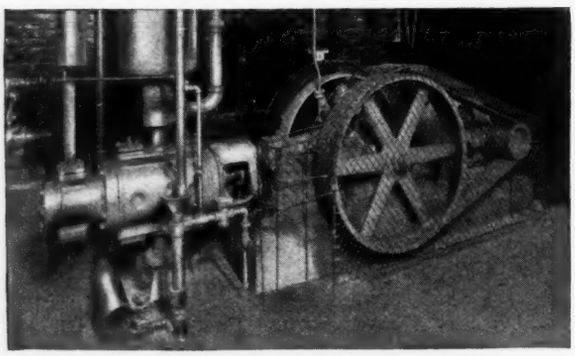
Single- and four-cylinder electric plants

warm weather. The generator is of the compound-wound type and especially insulated to withstand unusual moisture and heat conditions. The coupling is of special design having a torsion spring arrangement to absorb the explosion impulses of the engine.

The lower view shows the general construction of four-cylinder water-cooled units, which are available in a number of sizes, ranging from 1½ to 15 kw. direct-current, in either 110 or 220 volts. Certain types can be had for 32-volt circuits. Other units included in the line are a 400-watt, 12-volt battery-charging set; single-cylinder units with take-off pulley; and units complete with sheet-metal housings. Units are also available for operation on natural gas.

Compound Air Compressor With Single-Acting High-Pressure Cylinder

USE of a single-acting, high-pressure cylinder and a double-acting, low-pressure cylinder characterizes a new line of two-stage tandem-type air compressors designated Class 14A and 15A put out by the Pennsylvania Pump & Compressor Company, Easton, Pa. The compressors constituting the new line are available in strokes from 5 to 8 in., inclusive, for the power-driven and from 6- to 8-in. stroke, inclusive, for steam-driven, and for pressures up to 250 pounds.



Motor-driven compound compressor with single-acting high-pressure cylinder

A plunger at the outer end of the rod acts as the piston for the high-pressure cylinder, and compresses air in this cylinder at only one stroke of the rod. As no distance piece is used between the cylinders, the over-all length of the unit is considerably reduced. An intercooler is incorporated in the air connection between the two cylinders. The units are equipped with the Pennsylvania air-cushioned, ring-plate valves.

Alloy-steel helical spring movement

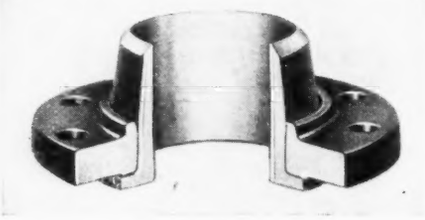
Steel Spring Recording Gages

THE FOXBORO COMPANY, Foxboro, Mass., has recently brought out an alloy-steel helical spring movement for its recording gages. This new movement is of one-piece tubing, all-steel and all-welded. It is suitable for use on gas, water, steam, oil, air, brine, chemicals, etc., where the pressures do not exceed 2,000 lb. per square inch.

The alloy-steel movement may be specified with new recording gages or may be ordered separately to be installed in old recording gages now in operation.

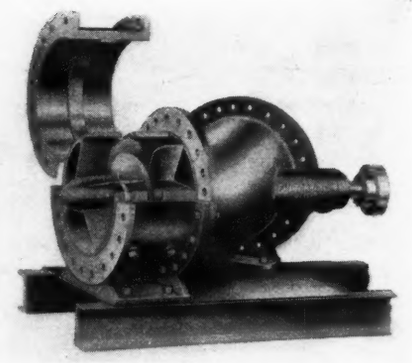
Swivel Flange for Welded Pipe Lines

DEVELOPED especially for use in connection with welded pipe lines where a joint is required for insertion of a valve or fitting, the swivel flange illustrated is available in sizes from 2½ to 10 inches.



Flange and nipple

It consists of a drop-forged steel flange, fitted to a drop-forged tapered nipple on which the flange may be rotated, permitting alignment of bolts. The nipple is forged from a solid steel billet, and has a thickness at the base, where the highest stress occurs, much greater than the normal thickness of the pipe. The tongue-and-groove type of flange can be supplied when desired. The flange is put out by the Merco Nordstrom Valve Company, 343 Sansome St., San Francisco, Calif.



Pump with top half of casing raised

Axial-Flow Pump

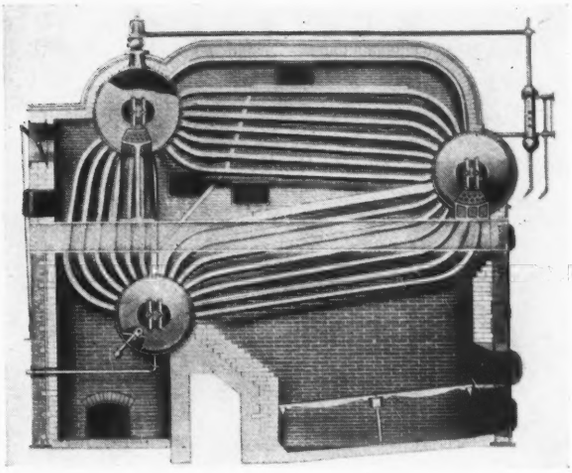
RECENTLY developed by the Fulton Iron Works Company, of St. Louis, Mo., the Fulton-Gill axial-flow pump is suitable for a variety of uses in the power plant field. In its ordinary form the pump consists of an impeller with three to six blades operating between two sets of guide vanes in a section of the pipe conveying the fluid. An internal bearing is carried by a boss supported by the outlet guides, and the shaft is carried out through a stuffing box, which also supports the thrust bearing.

Another form made specially for high-consistency fluids has two impellers revolving in opposite directions in a section of the pipe, the advantage of this type being that no guide vanes are necessary, although there is the complication of the double drive. Pumps of this type have been in use on 6 to 8 per cent consistency stock.

In both types of pump the flow is kept axial by a special distribution of pitch of the impellers, and there is no tendency for solid matter in suspension to separate and segregate. The action of the impellers in "slicing" the fluid has a useful macerating effect and insures thorough mixing of

the stock. Running clearances are large, and there is no necessity for fine adjustment, so that the pump maintains its efficiency in service.

Pumps of the single-impeller type are in use in sizes from 200 to 90,000 gal. per minute. In addition to water pumping they are used for pumping mud and such special fluids as fused nitrates and caustic soda at temperatures approaching dull red heat. These pumps can be made of special Fultonite nickel chromium in sizes to suit practically every purpose.



Keeler Type B.P. low-head water-tube boiler

New Pipe Wrench

DESIGNED to give positive action and unusual strength, the two principal parts of the new "Walco" pipe wrench put out by the Walworth Company, Boston, Mass., are of drop-forged high-carbon steel. The threads on the jaw are made with rounded crests to resist damage in use and to avoid jamming in the nut. A new design of nut provides a raised surface on each side of the knurl to protect it from battering. Sizes range from 6 to 48 inches.

Low-Head Three-Drum Water-Tube Boiler

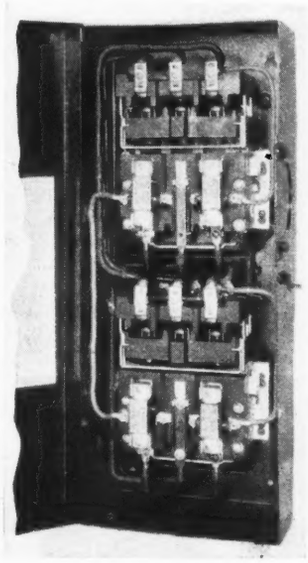
DESIGNED for installation where headroom is limited, the Type B.P. water-tube boiler recently brought out by E. Keeler Company, Williamsport, Pa., is available for power and heating service in a wide range of sizes and working pressures.

As will be apparent from the illustration, the boiler comprises three drums connected by bent tubes. The tubes are 3½ in. in diameter and there is approximately the same number of tubes in each bank. According to the manufacturer, this arrangement of drums and tube banks gives unrestricted and balanced circulation at all ratings. The main tube bank is inclined, and the entire lower row is exposed to the radiant heat of the furnace.

The boiler is suspended independently of the brickwork by a structural-steel frame. The two upper drums are supported from a cross-member as shown, and the lower drum is carried by the tubes. By reason of the compact design many of the smaller and medium-sized units can be shipped completely assembled. Although the illustration shows a unit equipped for hand firing, the setting can be arranged for stoker firing of coal, as well as for gas or oil firing.

Reversing Across-the-Line Starter

THE Condit Electrical Manufacturing Corporation, Boston, Mass., has brought out a reversing across-the-line motor starter for control and protection of squirrel-cage induction motors.



Starter with cover open

The starter, known as type A30R, consists of two of the type A30 arc-preventing motor starters mounted in a single inclosing case and mechanically interlocked.

Both starters are equipped with thermal relays for time lag overload protection. The type A30R starters are for push-button control up to 20 hp., 550 and 440 volts; 15 hp., 220 volts and 7½ hp., 110 volts.

Beaver 2½ to 4 in. pipe cutter

Square-End Pipe Cutter

INCORPORATING the standard Beaver principle of self-feeding knives, the new 2½ in. to 4 in., square-end pipe cutter put out by the Borden Company, Warren, Ohio, is gear-driven, and has a driving pinion in front similar to No. 41 die stock. This permits interchangeability between pipe cutter and die stock when used with power drives. A single wrench is employed for centering the tool on the pipe, by means of centering V-blocks, and the same wrench is used to place the knives under compression. The knives have a guide running ahead of the cutting edge to prevent breakage.

NEWS of the FIELD

Spot News

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REORGANIZATION *of the Federal Power Commission under the new law was completed by the Senate Dec. 20, when it confirmed the remaining three nominations to membership on the commission. The other two had been confirmed on Dec. 19. Three of the new commissioners—George Otis Smith, chairman; Claude L. Draper, and Marcel Garsaud—were sworn into office on Dec. 22. The first act of the new commission was to effect the dismissal of Solicitor Charles A. Russell and Chief Accountant William V. King and the resignation of Executive Secretary F. E. Bonner.*

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BY A DECISIVE VOTE, *the national water-power policy of the United States Chamber of Commerce has been approved in a referendum of 1,147 of its members. Among other recommendations, the policy advocates sale or leasing of Muscle Shoals and regulation of interstate power by state agencies. The vote on the Muscle Shoals recommendation was almost unanimous.*

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FINAL PLANS *and specifications for the construction of Hoover Dam together with the standard forms to be used in bidding will be available Jan. 10, 1931, at the offices of the Bureau of Reclamation in Washington, D. C., Denver, Colo., or Las Vegas, Nev., Secretary of the Interior Wilbur has announced. Bids will be opened on March 4, 1931, at the Denver office, and construction will start on April 10, according to present plans.*

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ANNOUNCEMENT *that tests of two elevators operated independently in the same shaft were being successfully completed by a large elevator company was made last week by Frank J. Sprague, electrical engineer of New York City who invented the system of operation.*

Trade Commission Report Shows Increase In Interstate Transmission of Power

ELECTRIC POWER is moving across state and national boundaries in increasing volume and conditions seem to point to future expansion in long distance transmission and a resulting disregard of state lines in the supply of electricity, the Federal Trade Commission declares in the final report of its investigation on interstate power transmission sent to the Senate Dec. 20.

The fact that the United States, by reason of technological developments generally in the science of communications, is becoming in effect smaller, would seem to suggest an increasing disregard of state lines in electricity supply as in other phases of industry and trade, the report states.

The commission sought primarily to determine the state and national totals for interstate movement of power in the year 1929 and to compare them with the generated and consumed quantities by way of rates, for the United States as a whole and for the individual states.

Electric energy generated in the United States in 1929 totaled 95,582,000,000 kw.-hr. Gross ratio of quantities exported across state lines to quantities generated during 1929 was 15.18 per cent. Similar gross ratio of quantities imported to quantities consumed was 19.64 per cent.

Difference between the two ratios is partly due to losses between points of generation and consumption, which reduce the total quantity received by consumers by as much as 15,000,000,000 kw.-hr. The size of the imports ratio is also affected by the fact that imports over international boundaries into the United States are 1,400,000,000 kw.-hr. in excess of exports. Aside from this difference between exports to and imports from Canada and Mexico, the aggregate for exports and imports across the boundaries between states is identical, since exports of one state are imports of another.

After excluding railroad operations, the ratio of exported to generated electricity becomes 15.41 per cent of that of imported to consumed electricity 21.49 per cent for the United States as a whole. Exclusion of certain figures for municipal and governmental plants would further increase these ratios of exports to generated.

The following table of kilowatt hours summarizes the movement of electrical energy across state boundaries (including those of the District of Columbia) for the United States as a whole (excluding Alaska and outlying possessions) and total ratios for 1929:

Outward movement across state boundaries, 14,505,190,623; inward movement across state boundaries, 15,906,132,127; total electrical energy generated in the United States, 95,582,144,161; total electrical energy consumed in the United States, 80,968,440,669; ratio of outward movement to generated, 15.18 per cent; ratio of inward movement to consumed, 19.64 per cent.

The southeastern states show the highest ratios of interstate movement in proportion to quantities generated and consumed. The South Atlantic geographic division ranks first as regards exports ratio, and second as regards imports ratio, while East South Central geographic division ranks third as regards the exports ratio and first as regards the imports ratio. New England is second in exports ratio and third in imports ratio, while the Pacific States rank lowest in both ratios.

New St. Lawrence Power Plan Expected Jan. 15

FOLLOWING the announcement Dec. 22 of a successful preliminary conference between the St. Lawrence Power Development Commission of New York and the Ontario Hydro Electric Commission, it was intimated that the New York commission will present to the state legislature on Jan. 15 a complete plan for public construction and operation of the proposed hydroelectric plant on the St. Lawrence. It will recommend that the legislature create at once a permanent board of power trustees empowered to negotiate contracts and to untangle the legal problems surrounding the undertaking.

One reason for the successful preliminary conference, it was learned, is the development of an entirely new engineering plan for the proposed dam which the New York commission believes will remove the objection of Cana-

dian engineers to a "single stage" project. Hitherto the Canadian engineering authority has advocated the harnessing of International Rapids by two dams.

The new plan sets the cost of dam construction from $220,000,000 to $250,000,000, the same as for the dam devised several years ago by engineers for the General Electric, Mellon and Carlisle interests when they attempted to obtain an option on a lease of the site at Barnhart Island.

The commission, it is understood, has reached no decision among several alternative schemes for marketing New York's half of the power. It is considered entirely possible that it will propose at least two plans, one supposing that suitable contracts can be drawn with the Niagara Hudson Power Corporation for transmitting and distributing the power and the other supposing that it is impossible to negotiate suitable terms with the power corporation. The latter plan would incorporate Governor Roosevelt's proposal for transmission by the state.

Calif. Company Expects 350,000-Hp. Load Increase

New business amounting to 350,000 hp. is anticipated by the Southern California Edison Company, Ltd., for 1931, according to R. H. Ballard, president of the company. This will be composed, he said, of new industrial, agricultural and domestic load, both from present consumers as well as 27,000 new consumers in Los Angeles and throughout Southern California who will apply for service next year.

The diversity of this anticipated new business is indicated in quotas established by the company for 1931. The quotas are: domestic and commercial heating and cooking, 110,000 hp.; industrial power, 70,000 hp.; residential and commercial lighting, 68,000 hp.; oil field power, 47,500 hp.; agricultural, 40,000 hp.; industrial heating, 12,500 hp., and street lighting, 2,000 horsepower.

Organize Municipal Power Defense League

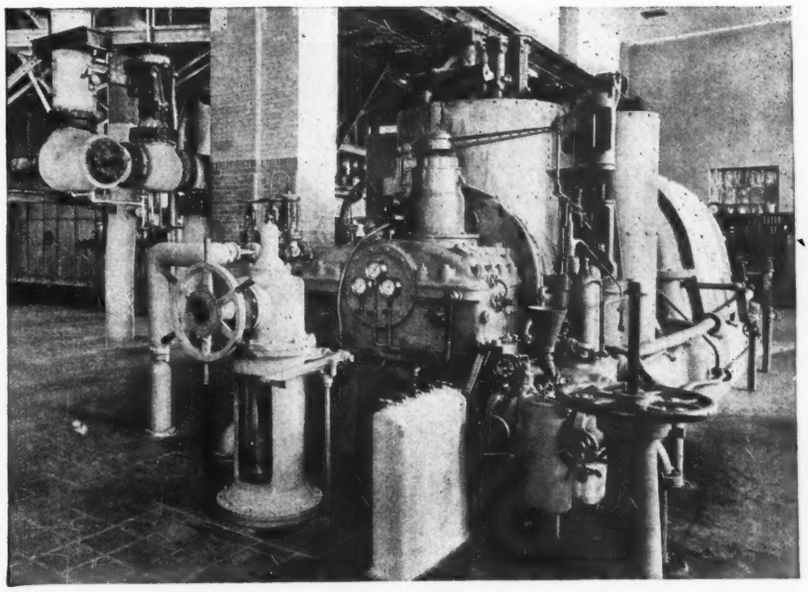
ORGANIZATION of the Municipal Light and Power Defense League has been announced at Los Angeles, Calif. The purpose of the organization, according to a statement issued when formation of the league was announced, is to keep the public fully informed as to the facts regarding the municipal power system and to support competent and efficient officers and employees of the system from attack.

Officers of the league are Franklin D. Howell, president; Judge Leslie R. Hewitt, vice-president; Miss Mary J. Workman, second vice-president, and Seward C. Simons, secretary.

The league's first statement also said: "It is our conviction that the city's municipal power system is one of the greatest assets of Los Angeles, saving money to the home owner, the renter, the merchant and the manufacturer and assisting in the establishment and growth of our factories by reason of the cheap rates for electricity that it makes possible.

"We shall resist attacks upon the municipal power system on the part of any private or special interest, and shall support and promote its development in the interest of all our citizens."

GILBERT HIGH-PRESSURE UNIT



The high-pressure element of the 55,000-kw. turbine-generator set recently placed in operation in the new Gilbert Station of the New Jersey Power & Light Company at Holland, N. J. This set, which operates at 3,600 r.p.m. on steam at 1,200-lb. pressure, was made by the General Electric Company

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Leipzig Trade Fair To Open in March

ANNOUNCEMENT has just been made that the Leipzig Trade Fair will be held next year from March 1-7. Comprising 10,000 exhibits, assembled from 22 countries, it will constitute the largest and most varied market in the world, the announcement states. The exhibits of similar merchandise will be displayed in the same or closely grouped buildings. There will be some 67 buildings in all, including the largest exhibition halls ever erected.

An attendance of some 200,000 buyers is expected at the fair, including 30,000 from foreign countries. The United States will send more than 100 characteristic exhibits and upwards of 2,000 buyers from all parts of the country. A special American headquarters will be established and every facility offered for transacting business.

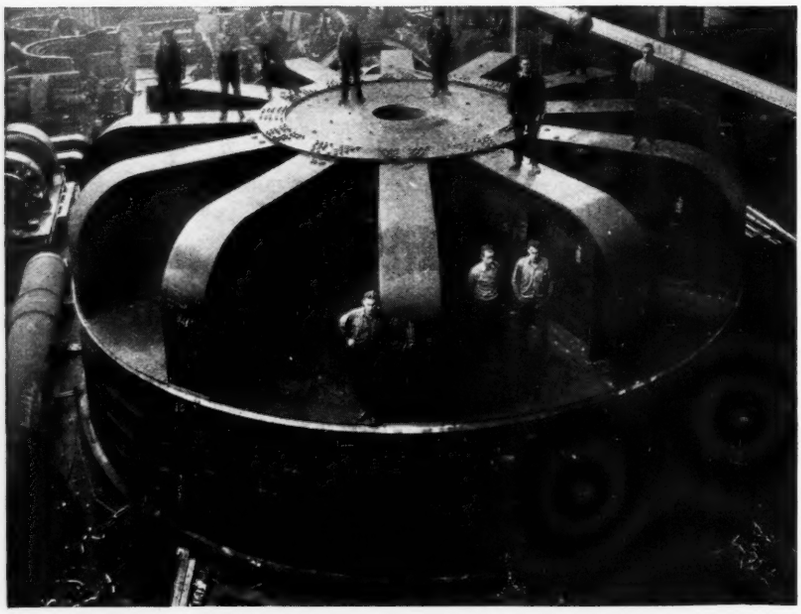
News of Canada

May start Carillon Falls project soon — Ontario Liberal Party favors St. Lawrence scheme— Vancouver industrials oppose Campbell River development

DEVELOPMENT of a huge project by which the Shawinigan Water & Power Company will obtain a maximum of 600,000 hp. from the Carillon Falls, on the Ottawa River, about half-way between Ottawa and Montreal, is believed to be near at hand. Proposals have been made to the Quebec government and while details of any discussions are being carefully guarded, Premier Taschereau of Quebec has stated that the scheme is being considered. It is understood that the company is prepared to proceed with the project which would be almost identical in magnitude with that of the Beauharnois company on the St. Lawrence.

For three or four years, at the suggestion of federal authorities, the two provinces have had engineers at work intermittently seeking a basis for development by the two provinces of power on the Ottawa River, both above and below the city of Ottawa. The result thus far has been a big scheme in progress by the Ontario Hydro Electric Power Commission at Chats Falls, where a power house is being built with an initial installation of 224,000 hp. The site is 30 miles above the city. While no concrete proposal has yet been

DNIEPER UNIT NEARS COMPLETION



Approximately one-fifth of 1,750,000 lb., the total weight of an 84,000-hp. hydro-electric generator is represented in the combined weight of the thrust bearing bracket and stator frame here shown assembled in the Schenectady Works of the General Electric Company. This machine when installed and in operation at the Dnieper River Station, U.S.S.R., will generate 77,500 kva.

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submitted to the federal authorities in connection with the Carillon scheme, it is expected that within the next few weeks, probably before the opening of Parliament, proposals will be made and another conference held in Ottawa.

THE LIBERAL PARTY in Ontario has gone on record as favoring the St. Lawrence River canalization and power scheme as a joint international venture between Canada and the United States. In passing a resolution to this effect at a recent convention in Toronto, the party urged upon the federal government the advantages of concluding an early treaty with the United States.

At the same time strong objection was taken to "the policy of obstruction by Ontario of the entire scheme," and a resolution was passed calling for the cessation of such obstruction.

The convention also went on record as disapproving and condemning the policy of the Conservative party in purchasing high-priced power from companies outside the province.

COMMERCIAL ORGANIZATION on Vancouver Island, British Columbia, are advocating the development of the use of steam power rather than hydro-electric energy for industry, and on this basis are objecting to plans of the British Columbia Power Corporation for utilization of the Campbell River as a power plant site. Several months ago the corporation was given authority by the provincial government to proceed with the establishment of a large power plant at Campbell River, and although the company was required to submit detailed plans before construction started, it was taken for granted that the project would go ahead. It was proposed to establish one of the largest hydro plants on the coast, to supply power for industries on Vancouver Island from the Campbell River southward.

Members of the Victoria Chamber of Commerce, however, are averse to utilization of the Campbell River for this purpose when there is an abundance of coal on the island, use of which would probably mean a wider distribution of revenue.

Southwest Lighting School To Open in February

The second annual School of Lighting Practice sponsored by the Southwestern Geographic Division, National Electric Light Association, will open in New Orleans, La., during the early part of February, 1931. This school will be held at Tulane University under the joint auspices of Tulane's College of Engineering and the division for the purpose of bringing the latest ideas in the lighting field to those people in the Southwest who are interested in illumination. Nationally known leaders of the lighting industry will address the classes, which will be held in the afternoon and evening to permit attendance by those engaged in business.

Personals

FRANK H. WILLARD, president of the Graton & Knight Manufacturing Company, was elected president of the Power Transmission Association at its recent annual meeting held in New York City. Other officers elected were: vice-president, W. R. SIMPSON of the American Pulley Company, and secretary-treasurer, D. W. MCALLEN of SKF Industries, Inc.

P. B. EATON, associate professor of Lafayette College, Easton, Pa., has recently been promoted to full professorship in the department of mechanical engineering.

R. H. REID, formerly with the Gatineau Power Company at Ottawa, Ont., is now on the engineering staff of the Beauharnois Construction Company at Beauharnois, Que.

P. C. KIRKPATRICK has joined the staff of the Ontario Power Service Corporation and is located at Fraserdale, Ont. He was formerly with the Fraser-Brace Engineering Company at Copper Cliff, Ont.

A. E. STRONG, since 1928 general superintendent of the Coast Counties Gas & Electric Company, Santa Cruz, Calif., will be temporarily affiliated with the Natural Gas Properties, Inc., under the direction of the Standard Management & Operating Corporation of San Francisco, as general manager of the Washington and Oregon Division. His headquarters will be in Portland, Ore. In his position as general manager, Mr. Strong will superintend the construction of butane plants throughout the Northwest.

C. A. WOLFROM, manager of the Salt Lake division of the Utah Power & Light Company, was recently elected president of the Electrical League of Utah. Mr. Wolfrom has had a wide experience in the operation and management of central stations in the West, having been in charge of many power plants since he first became associated with the light and power industry in 1902.

L. M. CARGO, Mountain States representative of the Westinghouse Electric & Manufacturing Company, was elected Dec. 17 president of the Electrical League of Colorado. Other officers elected were: vice-presidents, W. A. J. GUSCOTT, J. J. COOPER, E. E. BRAZIER and R. G. GENTRY; secretary, E. E. HEADRICK; treasurer, DEAN D. CLARK.

MAJOR H. EARLE, resident engineer in charge of construction at the British Columbia Power Corporation's Jordan River project on Vancouver Island, has returned to Victoria, B. C., with the completion of the fourth 18,000-hp. unit at the plant. Installation of the new unit raises the capacity of this development to 39,500 hp.

Business Notes

AMERICAN ENGINEERING COMPANY, Philadelphia, Pa., announces the receipt of an order for two large stokers of the "Delray" type to be installed in the Gennevilliers Station in Paris, France.

PANGBORN CORPORATION, Hagerstown, Md., announces the opening of district sales offices in Cincinnati and Milwaukee, effective Jan. 1. An innovation is the appointment of Thomas J. Dougherty as a special sales engineer at the home office to cover the Hagerstown district. The revised addresses of the complete list of district sales offices are as follows: Chamber of Commerce Building, Boston, Mass., district sales engineer Harold Holden; 444 Railway Exchange Building, Chicago, Ill., district sales engineer W. C. Lytle; Cincinnati, Ohio, district sales engineer E. C. Gilmour; 401 Western Reserve Building, Cleveland, Ohio, district sales engineer R. E. Donnelly; 313 Stephenson Building, Detroit, Mich., district sales engineer Charles T. Bird; 30 Church St., New York City, district sales engineer W. F. Jones; 246 West Upsal St., Philadelphia, Pa., district sales engineer W. T. Randall; Chamber of Commerce Building, Pittsburgh, Pa., district sales engineer F. E. Wolf; St. Louis, Mo., district sales engineer R. M. Trent; 124 Niven St., Syracuse, N. Y., district sales engineer Bruce R. Artz; Plankinton Building, Milwaukee, Wis., sales engineer H. O. Cost.

PANAMA RUBBER COMPANY, Chicago, Ill., announces that effective Jan. 1, 1931, the name of the company will be changed to KABLE KORD BELTING, INC. This change is made, the company states, to identify more closely the name of the company with its product, Kable Kord Belting, and coincides with a new financial set-up that adds machinery and improvements to its present facilities. The company also announces that its sales for 1930 have substantially surpassed those of 1929.

FLAKICE CORPORATION, Newark, N. J., reports an increasing demand for its products and announces that it has just effected license agreements with prominent makers of ice and refrigerating machinery builders abroad to build and market its equipment in Europe.

AMERICAN HOIST & DERRICK COMPANY, St. Paul, Minn., announces the purchase of new warehouse facilities in Chicago to supplement its offices at 205 West Wacker Drive. Complete stocks of new machines and repair parts will be maintained at the new warehouse, the announcement states.

THE MARLEY COMPANY, Kansas City, Mo., announces the opening of a direct district sales office at 6 East 45th St., New York City. J. C. Albright, formerly with the Bailey Meter Company of Cleveland, Ohio, is in charge of the new office as district manager.

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Engineering Council. Annual meeting at the Mayflower Hotel, Washington, D. C., Jan. 15-17, 1931. Secretary, L. W. Wallace, 26 Jackson Pl., N.W., Washington, D. C.

American Institute of Electrical Engineers. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29, 1931. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6, 1931. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15, 1931. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Trade Catalogs

REFRACTORIES — Recent revision has been made of the motion picture "Story of Fire Clay Refractories," which was originally produced in 1923 under the direction of the Bureau of Mines in co-operation with the Laclede-Christy Clay Products Company of St. Louis, Mo. Three reels in length, the picture deals with the manufacture and applications of fire-clay products in an interesting and realistic manner. It is available in 35- and 16-mm. sizes and is distributed free of rental charge as motion picture subject No. 97 by the United States Bureau of Mines, Pittsburgh, Pa.

TACHOMETERS—The Brown Instrument Company, Philadelphia, Pa., has just issued a new catalog, No. 46, covering indicating and recording tachometers in various models, together with the electric generators used in their operation. Illustrations and data covering standard applications of this equipment are included in the publication.

COOLING SYSTEMS AND TOWERS—Two new bulletins on cooling systems have just been issued by the Cooling Tower Company, 15 John St., New York City. Bulletin 302 illustrates and describes spray nozzle cooling systems, and Bulletin 303 gives complete data on atmospheric cooling towers. Construction details, blue-print layouts and capacity charts are included in the bulletins.

ASH STORAGE TANKS—The United Conveyor Corporation, Old Colony Building, Chicago, Ill., has just issued a new catalog covering its vitrified glazed tile ash storage tanks. Fully illustrated, the catalog presents details of design, construction, installation and operation of the tanks.

REGULATOR—The new Copes Type OT regulator, designed especially for horizontal return tubular, Scotch marine and similar types of boilers, is described and illustrated in a leaflet just issued by the Northern Equipment Company, Erie, Pa.

Fuel Prices

FUEL OIL

New York—Dec. 18, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Dec. 5, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.47 per bbl.; 28@30 deg., $1.595 per bbl.; 30@32 deg., $1.695 per bbl.; 32@36 deg., gas oil, 3.901c.@4.026c. per gal.; 38@40 deg., distillate, 4.651c.@4.776c. per gal.

Pittsburgh—Dec. 11, f.o.b. local refinery, 34@36 deg., fuel oil, 3.37½c.@3.5c. per gal.; 36@40 deg., 3.37½c.@3.5c.

Philadelphia—Dec. 16, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.26@$1.31 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Dec. 16, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Dec. 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 80c.@90c. per bbl.; 30@32 deg., $1.00@$1.05 per bbl.

Boston—Dec. 15, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

Dallas—Dec. 13, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.90 @$2.25
Pool 10, hr.gr. low-vol.	New York	1.75 @ 1.85
Pool 11, low-vol.	New York	1.60 @ 1.75
Smokeless, mine-run	Chicago	1.75 @ 2.25
Smokeless, slack	Chicago	.50 @ 1.50
Harlan, Ky., slack	Chicago	.50 @ .90
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.10 @ 1.60
Ind. 5th Vein, m.-r.	Chicago	1.50 @ 1.85
Standard Ill., mine-run	St. Louis	1.70
W. Ky., mine-run	Louisville	1.00 @ 1.35
W. Ky., slack	Louisville	.15 @ .30
Pittsburgh, mine-run	Pittsburgh	1.30 @ 1.60
Smokeless, mine-run	Cincinnati	1.75 @ 2.25
Smokeless, slack	Cincinnati	.75 @ 1.35
Kanawha, mine-run	Cincinnati	1.10 @ 1.35
Kanawha, nut-slack	Cincinnati	.35 @ .50

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.00
Barley	New York	1.15 @ 1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Hot Springs—U. S. Dept. of Interior, National Park Division, Washington, D. C., awarded contract for waterworks improvements, including two underground storage reservoirs, 100,000 and 400,000 gal. capacity, electric underground pumping system, 150 g.p.m. 150 ft. head, etc., for Hot Springs National Park here, to Wickes Engineering & Construction Co., Des Moines, Ia.

Calif., Costa Mesa — Southern California Edison Co., Third and Broadway, Los Angeles, plans the construction of an electric sub-station here. Estimated cost $100,000.

Calif., Los Angeles — State of California, awarded contract for the construction of a 13 story state office building at First and Spring Sts. to Weymouth Crowell Co., 2104 East 15th St. Estimated cost $1,250,000.

Calif., Pasadena—City is having plans prepared for superstructure of a 108 x 150 ft. electric light plant. Estimated cost $50,000. Bennett & Haskell, First Trust Bldg., are engineers.

Conn., New London — U. S. Coast Guard Academy, received lowest bid for the construction of a group of school buildings, including boiler house, storage building, etc., on Michigan St. from Murch Bros. Construction Co., Railway Exchange Bldg., St. Louis. Estimated cost $1,750,000.

Ill., Chicago—W. G. Uffendell, 39 South State St., Archt., will receive bids about Jan. 1 for the construction of a 13 story club building at Oakley and Lawrence Aves. for Northern Athletic Club, 2310 Lawrence Ave. Estimated cost $1,200,000.

Ill., Crystal Lake — Public Service Co. of Northern Illinois, 72 West Adams St., Chicago, awarded contract for the construction of a service headquarters building here, to C. E. Billings, Barrington. Estimated cost $175,000.

Ind., Richmond—City is having plans prepared for extensions and improvements to municipal electric light plant. Estimated cost $101,500. D B Davis, Richmond, is engineer.

Ia., Grundy Center—City voted $80,000 bonds for the construction of a light and power plant. J. W. Wiersma is engineer.

La., Colfax—City postponed bond election of $25,000 for waterworks system and $40,000 for electric light and power plant.

La., Lake Charles—Pure Ice & Cold Storage Co., awarded foundation and building contract for 1 story, 44 x 82 ft. ice plant to Bailey & Brewer, Pineville; ice equipment to York Ice Machinery Corp., 609 Tchoupitoulas St., New Orleans. Estimated total cost $26,328.

La., Oakdale—City is having plans prepared for the construction of a municipal light plant. F. P. Joseph, Genmora, is consulting engineer.

Md., Baltimore — Mayor and City Council, Municipal Bldg., will soon award contract for the construction of an automatic pumping station. G. Rost is water engineer.

Mass., Boston—Edison Electric Illuminating Co., 39 Boylston St., will soon receive bids for addition to steam heating plant at Kneeland and Utica Sts. Estimated cost $750,000. Bigelow, Wadsworth, Hubbard & Smith, 11 Beacon St., are architects. Whitney Engineering Co., 100 Arlington St., are structural engineers.

Mass., Boston—Treasury Department, Office of J. A. Wetmore, Supervising Architect, Washington D. C., will receive bids until Jan. 20 for superstructure of a 21 story post office at Post Office Sq. here. Estimated cost $6,000,000. Cram & Ferguson, 248 Boylston St., Boston, Mass., are consulting architects.

Mass., Worcester—Water Dept., awarded contract for the construction of a pumping station on Quinapoxet Pond to L. Rocheford & Son, Inc., 44 Front St. Estimated cost $15,000.

Mo., Osage—Missouri State Prison, c/o F. B. Jones, Dir. of Penal Institutions, Jefferson City, awarded contract for re-inforcing steel and steel windows for a group of buildings, including administration building, boiler house, etc., for intermediate reformatory, to Carter-Waters Steel Corp., 2440 Pennway, Kansas City, and Laclede Steel Co., Arcade Bldg., St. Louis. Work being done by convict labor.

Mo., St. Louis—St. Louis University, c/o R. Johnston, Pres., 221 South Grand St., awarded contract for foundation and footings for a 14 story hospital, including power house, connecting tunnels, etc., to McCormack-Coombs, Columbia Bldg. Estimated cost $1,000,000.

Mo., St. Louis—U. S. Engineer, 428 Custom house, received lowest bid for one 1,000 and one 100 kw. turbo-generator sets, switchboard and control equipment, and 1,000 hp. motor, for Dredge Fort Chartress from Elliott & Co., Railway Exchange Bldg., $23,313.

N. Y., Brooklyn—Supreme Coal & Ice Co., L. Tarielli, Pres., 551 Nostrand Ave., plans the construction of an ice manufacturing plant at Lexington and Marcy Aves. Estimated cost $75,000. Bly & Hamann, 551 Nostrand Ave., are architects.

N. Y., Central Islip — Dept. of Mental Hygiene, State Capitol, Albany, will receive bids until Feb. 4 for alterations to present dining room, kitchen building, service connections and power house equipment at Central Islip State Hospital here.

N. Y., Creedmoor—Dept. of Mental Hygiene, State Office Bldg., Albany, will receive bids until Jan. 14 for electric service connections and additional power plant equipment at Brooklyn State Hospital, Creedmoor Division, Borough of Queens, L. I.

N. Y., Long Beach—Knickerbocker Ice Co., 41 East 42nd St., New York, awarded contract for the construction of a 100 x 100 ft. ice plant here to Kuhn, Smith & Harris, 225 West 34th St., New York.

N. Y., New York—Horace Havemeyer, Islip, Long Island, awarded contract for the construction of a 14 story apartment building at 1 East 66th St. to C. T. Wills, 286 5th Ave., New York, N. Y. Estimated cost $1,600,000.

N. Y., New York—Metropolitan Life Insurance Co., 1 Madison Ave., awarded contract for the construction of a 28 story office building including power unit 4th Ave. between 24th and 25th Sts., to Starrett Bros. & Eken, 101 Park Ave. Estimated cost $10,000,000. Contractor will receive bids in January on separate contracts.

N. Y., New York—Wolab Realty Corp., c/o Farrar & Watmough, 10 East 40th St., awarded contract for the construction of an 11 story apartment building at 333 West 56th St., also 18 story apartment building at 330 West 57th St., to Henry Mandel, 10 East 40th St. Estimated cost $1,250,000 and $1,750,000 respectively.

N. Y., Ogdensburg—Dept. of Mental Hygiene, State Office Bldg., Albany, will receive bids until Jan. 7 for heating work, additional boiler capacity and equipment at Lawrence State Hospital here.

N. Y., Oswego—Harbor & Dock Commission, F. B. Shepherd, Pres., awarded contract for the construction of a grain elevator, 2,000,000 bu. capacity to Fegles Engineering Co., Oswego. Estimated cost $1,800,000.

N. D., Grand Forks—Bd. of City Commissioners, will receive bids until Jan. 14 for waterworks improvements including low lift pump house, mains, etc.

O., Mechanicsburg—Private Interests, c/o T. B. Ware, Atty., has been granted franchise for the construction of a new waterworks system, including pumping station and accessory plant. Estimated cost $65,000.

Okla., Cushing—City, voted $300,000 bonds for the construction of electric light and power plant. N. Bard is engineer. J. W. Flint is city manager.

Okla., Hominy—City voted $150,000 bonds for the construction of a municipal electric light plant. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Okla., Lawton — City postponed indefintely taking of bids for improvements to waterworks and distribution systems, including pumping station, seven motor driven centrifugal pumps, switchboard, electrical equipment, etc. $550,000. F. E. Lawrence, city engineer. Burns & McDonnell Engineering Co., 407 Interstate Bldg., Kansas City, Mo., Consult. Engrs.

Okla., Oklahoma City—W. B. Skirvin, First St. and Broadway, awarded contract for the construction of a 26 story hotel to Campbell & Price, 605½ West Main St. Estimated cost $2,000,000. Steam heating system, elevators, etc. will be required.

Okla., Oklahoma City—Young Men's Christian Association, 125 West Second St., awarded contract for a 10 story building on First St., to J. H. Frederickson, Baltimore Bldg. Estimated cost $500,000. Steam heating system, etc., will be installed.

Okla., Tulsa—City awarded contract for the construction of a waterworks pumping station to Standard Paving Co., 2119 East 11th St. Estimated cost $44,000.

Tex., Yoakum—City will soon receive bids for the construction of a waterworks and distribution systems including pumping plant, mains, etc.; will also receive bids about February for electric light and power plant consisting of dynamo unit, meters, extension to lines, etc. Estimated cost $250,000 and $200,000 respectively. Montgomery & Ward, Wichita Falls, are engineers.

Wash., Seattle—Bd. of Public Works, awarded contract for foundations for Diablo power house to Ward Construction Co., Tacoma, $279,847, also soon takes bids for copper conductor wire for high tension power wire from Diablo power house to the City of Seattle, in connection with hydro-electric project on the Skagit River, $800,000.

W. Va., Moundsville—City will receive bids in February or later for waterworks improvements, including pumping plant, etc. Supervising Engineers, Inc., 2 Cedar St., New York, are engineers.

Mexico, Reynosa, Tamaulipas—City will build a waterworks plant including pumping and filtration plants, etc. Estimated cost $100,000. Most of work will be done by day labor. Machinery contracts let.

Equipment Wanted

Boiler Settings—Washington, D. C.—Bureau of Yards, Navy Dept., will receive bids until Jan. 7 for air cooled settings for two 1,000 hp. water tube boilers.

Generator — Norton, Mass. — D. M. Runge, plans to purchase a motor generator outfit, large kw. capacity converting 110 ac. to 75 d.c.

Pump—Madera, Calif.—City Council, will receive bids until Jan. 5 for the installation of a 600 to 900 g.p.m. pump direct connected to electric motor for sewage disposal plant.

Pump—Ontario, Calif.—City, D. B. Wynne, Clk., will receive bids until Jan. 5 for furnishing and installing a centrifugal booster pump in pumping station No. 6.

Pump and Motor—Minneapolis, Minn.—City will receive bids until Jan. 5 for furnishing and installing a pump and motor in connection with waterworks. $15,000.

Industrial Projects

Calif., Long Beach—Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., is having plans prepared for the construction of a factory here. Estimated cost to exceed $350,000. A. Kahn, Inc., 1000 Marquette St., Detroit, Mich., are architects.

Ga., Atlanta — H. A. Varner, Rivers Rd., awarded contract for the construction of a 2 story, 50 x 200 ft. pencil factory on Houston St., to F. E. Varner, Standard Bldg. Estimated cost $50,000.

Ill., Mount Vernon—American Textiles Co., awarded contract for the construction of a 2 story, 84 x 100 ft. textile plant, to W. N. Atkinson, Mount Vernon. Estimated cost $40,000.

Ill., Peoria—Hubbell & Baker, Knoxville Rd., R. F. D., awarded contract for a 1 story, 80 x 135 ft. dairy plant, including refrigeration system, boiler room, etc., on University Ave., to F. Harbers & Son, Central Bank Bldg. Estimated cost $40,000.

Mass., Wellfleet—Powdrell & Alexander, Inc., 175 Connecticut Mills Ave., Danielson, Conn., is having preliminary plans prepared for the construction of a 1 story factory at Main St. Ext. here. Estimated cost $40,000. W. B. Brennan, 175 Connecticut Mills Ave., Danielson, Conn., is engineer.

Mich., Jackson — Sparks-Withington Co., awarded contract for the construction of a factory to North Moeller, Construction Co. Estimated cost to exceed $50,000.

Mo., Springfield—Springfield Tablet Mfg. Co., 300 North Jefferson St., awarded contract for a 2 story, 60 x 76 ft. addition to factory at Mill and Jefferson Sts., to M. E. Gillioz, Monett.

N. J., Jersey City—Jersey City Printing Co., 160 Maple St., will receive new bids about Mar. 1 for a 3 story addition to printing plant. Estimated cost $150,000. H. D. Scudder, Jr., 9 Clinton St., Newark, is architect.

N. J., Lakewood—Lakewood Studio Co., G. H. Glass, Pres., c/o D. J. Scrocco, 60 Park Pl., Newark, Archt., is having plans prepared for the construction of a motion picture theatre and radio broadcasting studio, including steam heating and ventilation systems, etc., at Pine Forest Manor here. Estimated cost $1,000,000.

Tex., Edinburg—Owner, c/o B. Hudgins, Secy. Chamber of Commerce, is having preliminary surveys made for the construction of a cotton seed oil mill, 50,000 ton of cotton seed annual capacity. Estimated cost $75,000. Equipment will be required.

Tex., Temple—Texas & Pacific Coal & Oil Co., plans the construction of an oil refinery. Estimated cost $500,000. Private plans. Part of work will be done by owner's forces.

Ont., Kitchener — Art Furniture Co., West Lancaster St., plans to rebuild factory recently destroyed by fire. Loss $150,000. Complete woodworking machinery will be required.

POWER

With which are consolidated *The Engineer* and the *Stationary Engineer*

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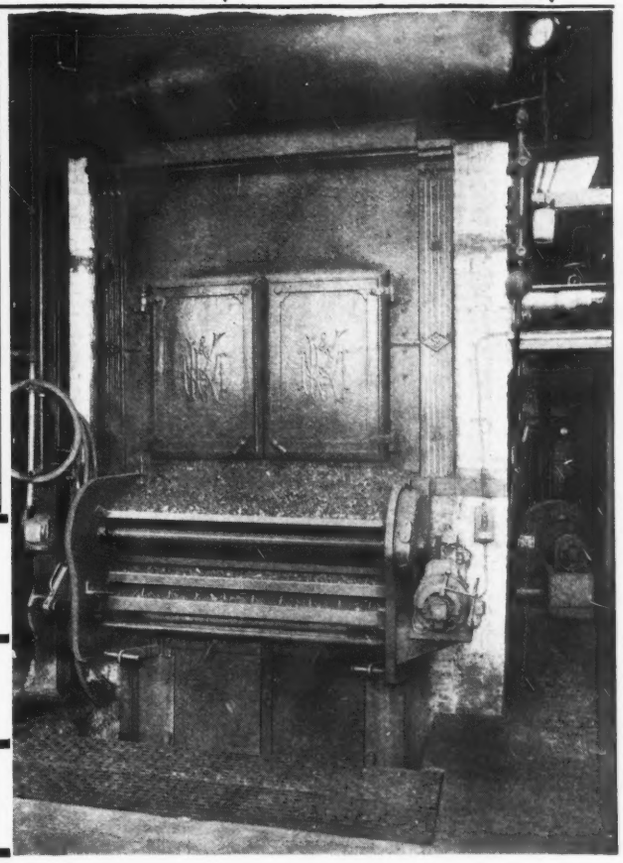

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Money . . . . with the J & J

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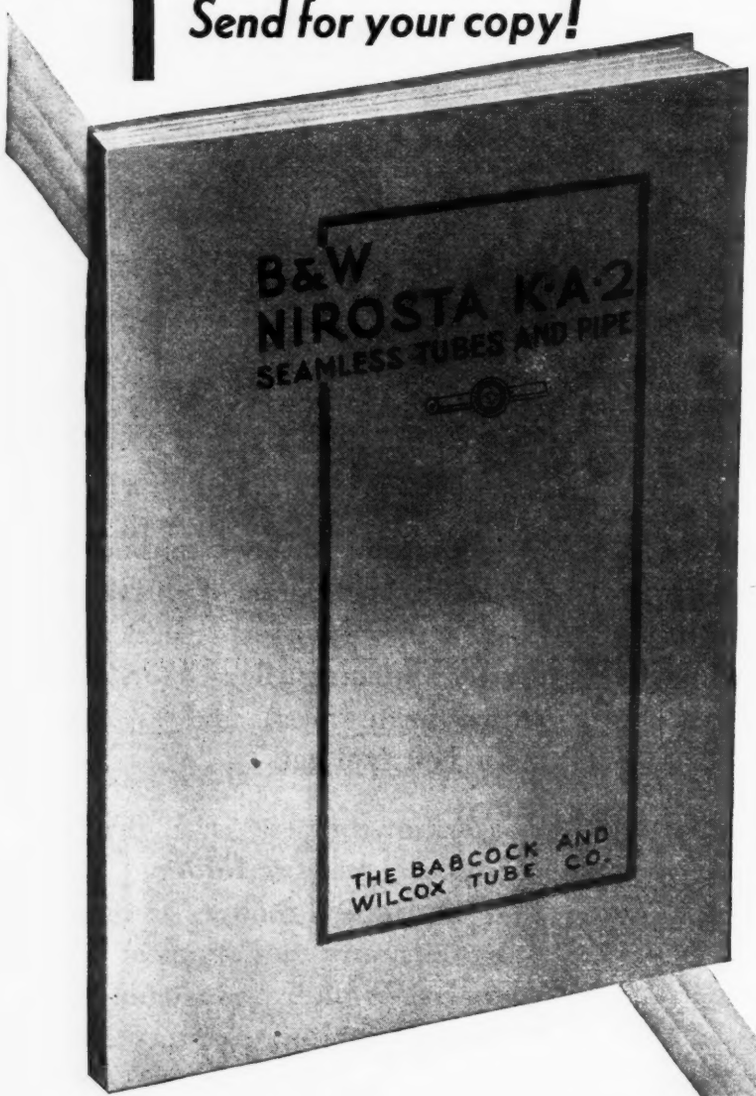

SINCE the publication of the first edition of this booklet in 1929, the use of B & W Seamless NIROSTA KA2 has been so wide as to provide a wealth of new information on this alloy.

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NIROSTA KA2

THE

BABCOCK & WILCOX TUBE COMPANY

BEAVER FALLS PENNSYLVANIA

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The COPES Type OT

This new COPES Regulator is rugged, compact, dependable. Easily installed and self-supporting. Simple, permanent adjustment. In every way worthy of the name COPES—the world-wide standard of long life and superior performance.

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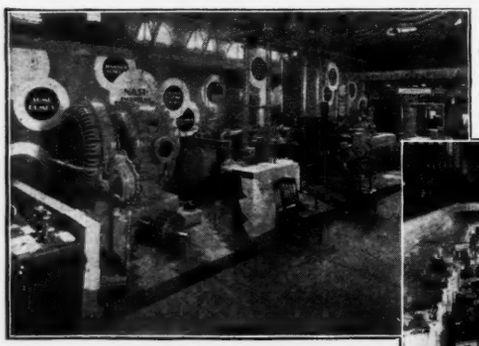

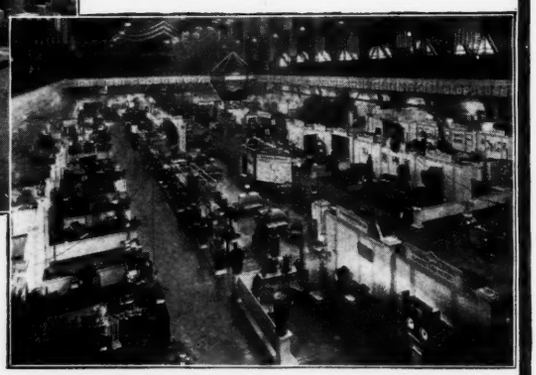

New Ways to Reduce Power Costs

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At The POWER SHOW

products of leading manufacturers will be on display and the men who created them will be on hand to answer questions — a veritable reservoir of ideas for you to tap. Make personal contact with these pioneers of research and gain from them direct information about new equipment and applications.

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Industry's outstanding meeting on power problems with diversified subjects, able authorities and latest practice. The program covers six sessions, three luncheon meetings and banquet. Sessions on "Power Economics", "Refrigeration", "Prime Movers", "Electricity", "Water Problems", and "Hydraulics" and "Subways" will all be notable events. The year's greatest power meeting.

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Meet with the Masters of Power at the Chicago Power Show

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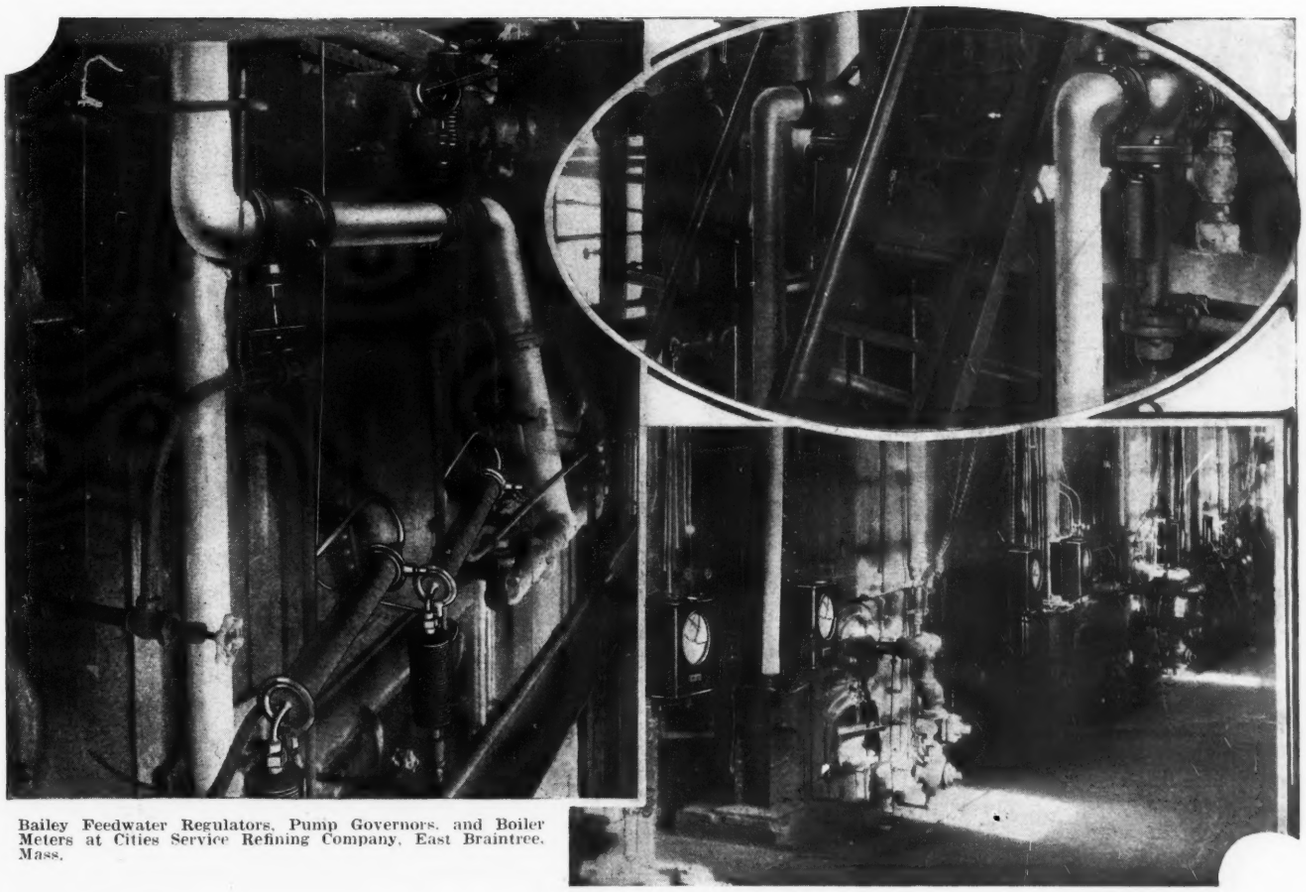

Bailey Feedwater Regulators, Pump Governors, and Boiler Meters at Cities Service Refining Company, East Braintree, Mass.

MEETING THE DEMAND FOR CHEAPER STEAM

Progressive industrial plants are now more than ever before realizing the need for economical power plant operation. Steam costs are a vital factor in keeping ahead of competition and widening the profit margin.

At the Cities Service Refining Company, East Braintree, Mass., the steam costs are kept at a minimum by use of Bailey Boiler Meters, Feed Water Regulators and Pump Governors. The Boiler Meters which record both Steam Flow and Air Flow guide the operators in obtaining best combustion efficiency. The Feed Water Regulators and Pump Governors insure effective boiler feed water regulation at all times.

In leading industrial plants throughout the country, Bailey Meter Equipment is meeting the demand for cheaper steam. If you are interested in an investment that will give you unusual returns, we suggest that you investigate the possibility of installing Bailey Metering and Regulating Equipment in your plant.

Write for bulletins No. 43, 43a and 82.

BAILEY METER CO.

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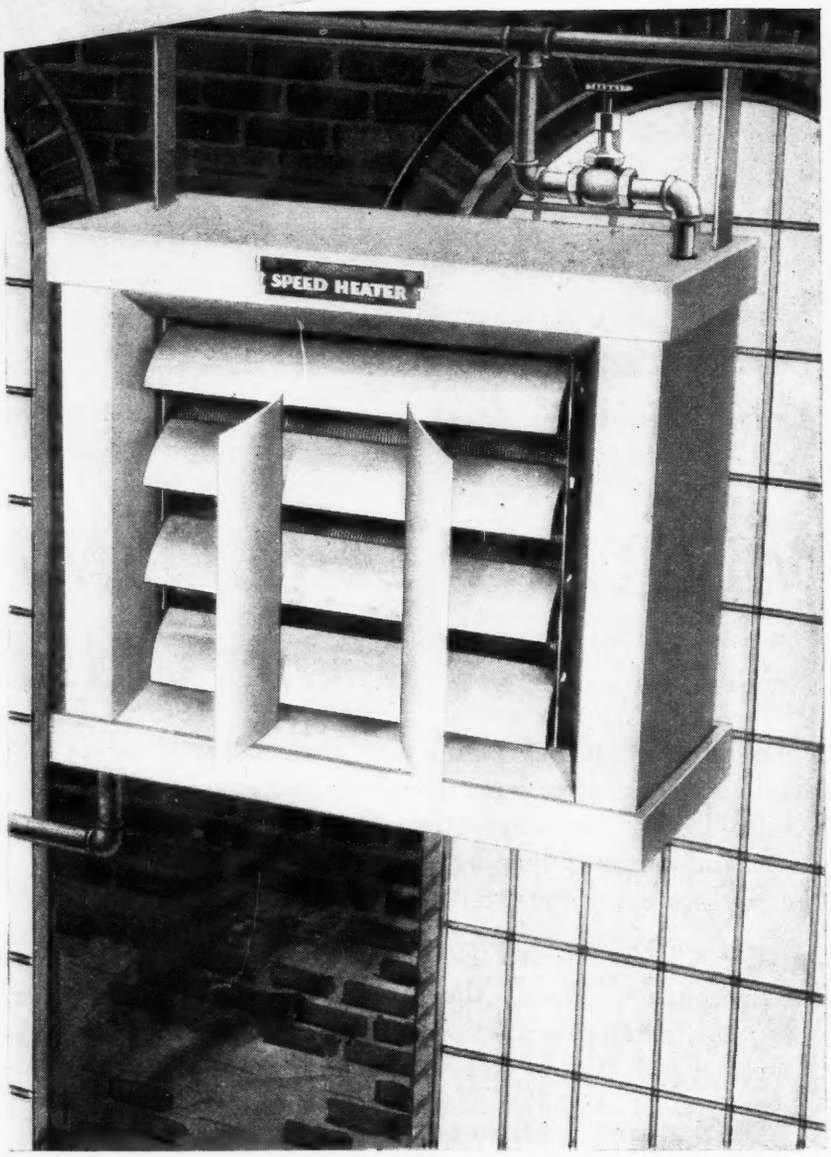
Need heat Speedily?

PHONE, WIRE OR WRITE FOR

THE SPEED HEATER



ARE THERE any heat-needy places in your plant? Any arctic zones ... cold spots ... draft-swept areas?

Why let shivery working quarters benumb production, why suffer from their discomfort ... when Speed Heater warmth can be supplied so quickly and easily?

Handy hangers permit the suspension of Speed Heaters in any location where heat is needed. Installation is a quick, easy job. Piping is extremely simple, as illustration shows.

Best of all, Speed Heaters for steam pressures up to 250 pounds and with standard voltage motors, D.C. or A.C., are stocked at vantage points and can be shipped within 48 hours.

If you need heat speedily ... phone, wire or write the nearest Sturtevant or Crane Co. office.

The Speed Heater is sold by B. F. Sturtevant Co.
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I would like a copy of "THE SPEED HEATER."
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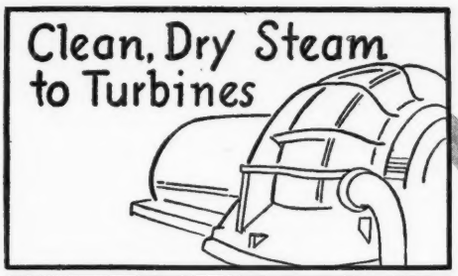
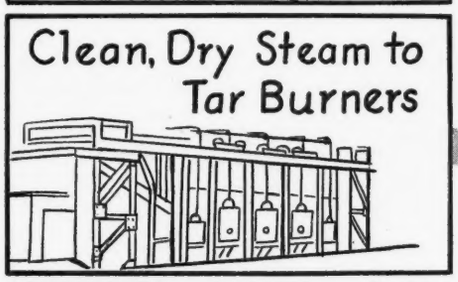
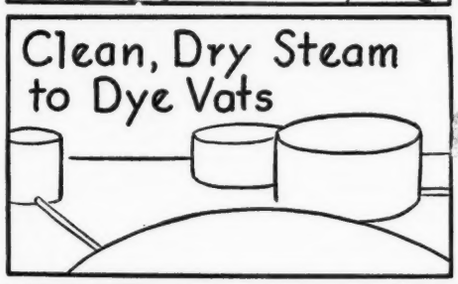
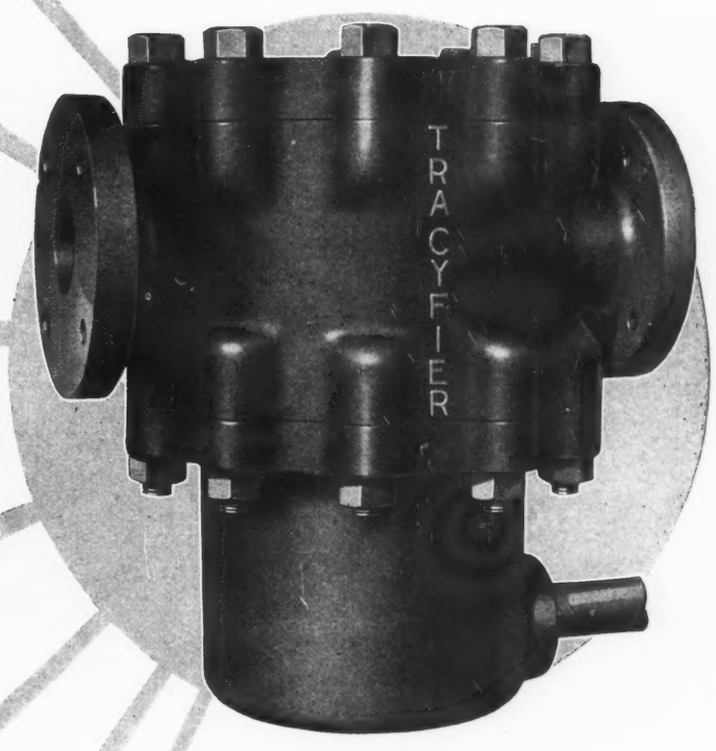
Sturtevant
(REG. U. S. PAT. OFF.)
SPEED HEATERS







The Pipe Line Tracyfier
HAS MANY USES
IN MANY INDUSTRIES



WHENEVER *absolutely* clean, dry steam, air, or gas, is wanted, the PIPE LINE TRACYFIER will deliver it. The same principles used as in the well known TRACYFIER, now in boilers aggregating over 3,000,000 H.P.

Delivery of STANDARD SPECIFICATION STEAM guaranteed. (Do not confuse this precision-built instrument with an ordinary separator.) Can be furnished to handle any quantity or pressure of steam, air, gas, or vapor.

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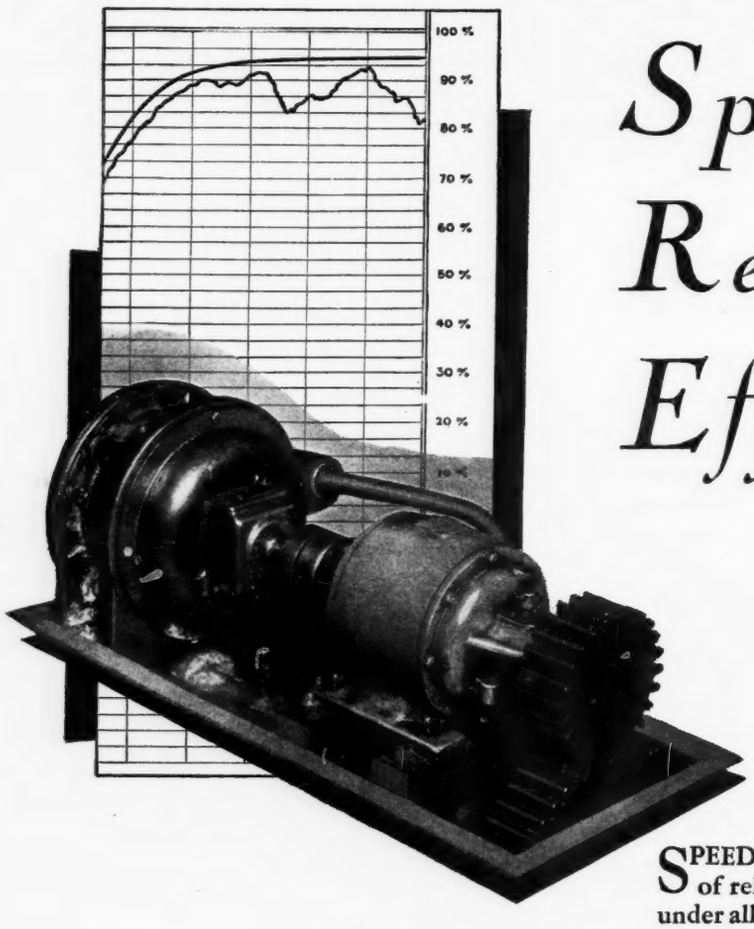
BLAW-KNOX

How Do You Measure



Speed Reducer Efficiency?

SPEED Reducer efficiency is a matter of reliable, unvarying performance under all conditions of speed and load. Sharp peaks and valleys in operating efficiency caused by heat, friction, shock or overload mean increased power consumption and possible damage to motor or driven machine.

G & F Speed Reducers, when used as recommended by our engineers, will give highly efficient and unvarying performance under all reasonable conditions of operation. Their point of highest efficiency is quickly reached and continuously maintained. Due to proper mounting and careful alignment of gears and shafts, friction and heat are practically eliminated. Bearings and shafts are of ample size to carry heavy overloads. Gears are accurately cut from forged blanks supplied by our own forge division.

Let our engineers recommend the size and type of Speed Reducer, Worm, Planetary, or Herringbone, that will give you the most efficient service. Our line is complete . . . you may rely on our unbiased recommendation.

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Drop, Flat Hammer and Upset Forgings
Cut Gears
Speed Reducers
Rolling Mill Machinery
Special Machinery
Bridge Operating Mechanisms

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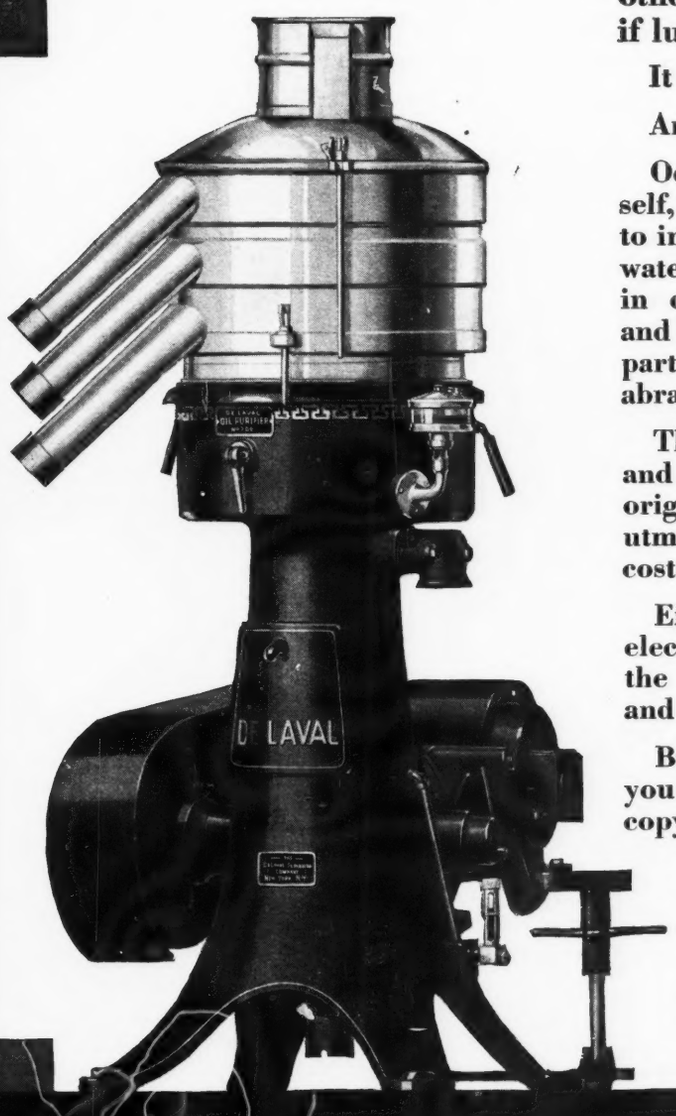
GEARS AND FORGINGS INC.

SPEED REDUCERS

THE BEARING DOESN'T FAIL



TRUE ENOUGH, one bearing may stand more punishment than another, but no bearing can long survive if lubrication is inefficient.

It is the oil that fails—not the metal!

And what causes oil to fail?

Occasionally the fault is with the oil itself, but far more often the trouble is due to impurities which it picks up in service: water which leads to detrimental change in chemical composition, emulsification and rapid formation of sludge; abrasive particles which puncture the oil film and abrade the bearings.

The De Laval Oil Purifier keeps oil clean and dry . . . . indefinitely maintains its original lubricating qualities . . . . assures utmost bearing protection at minimum cost.

Eighty-eight per cent of America's greatest electric power systems have given De Laval the task of keeping lubricating oil clean and dry.

Bulletin No. 106-P tells how and why you should do the same. Write for your copy today.

THE DE LAVAL SEPARATOR COMPANY
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600 Jackson Blvd., Chicago

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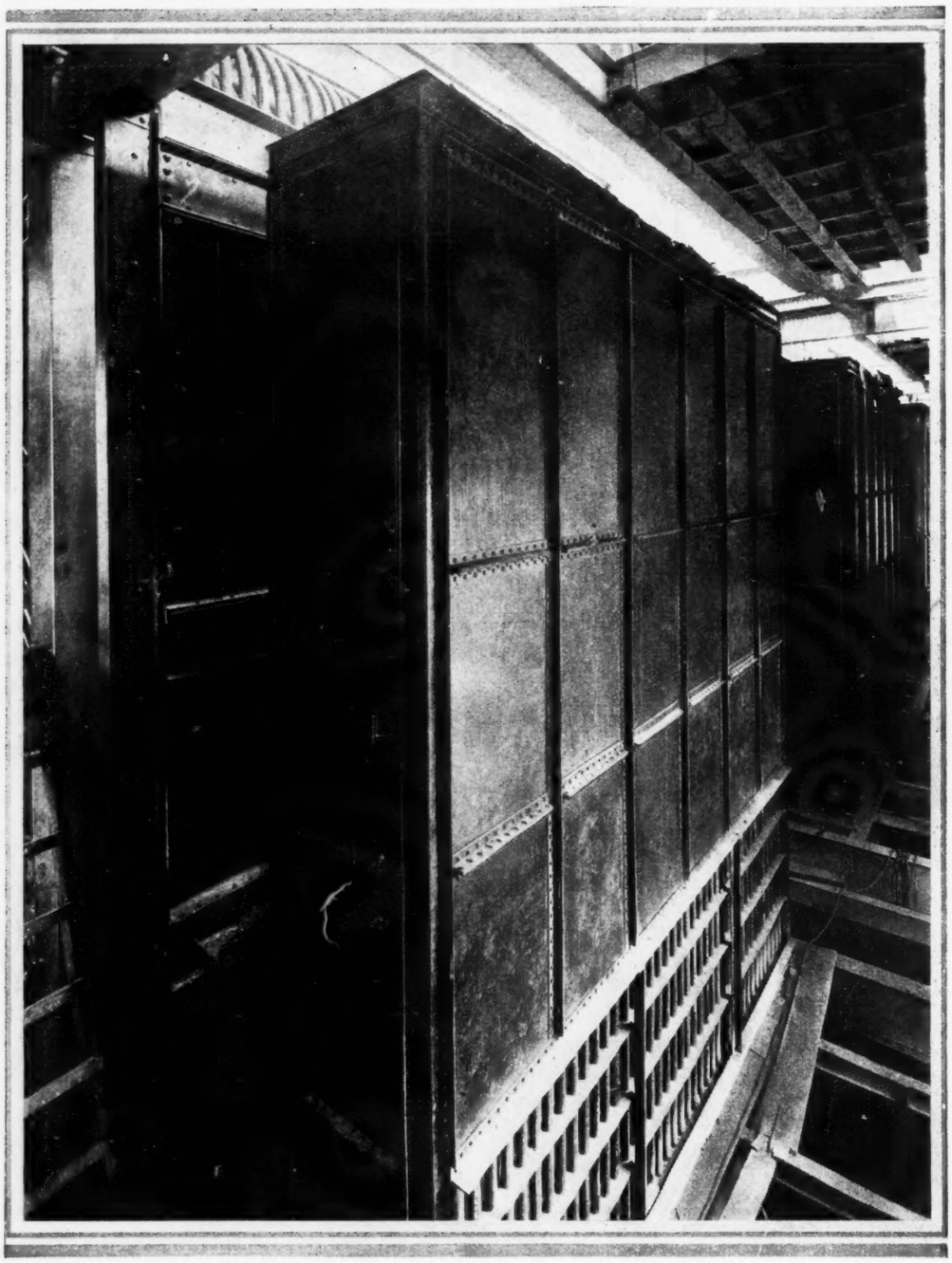
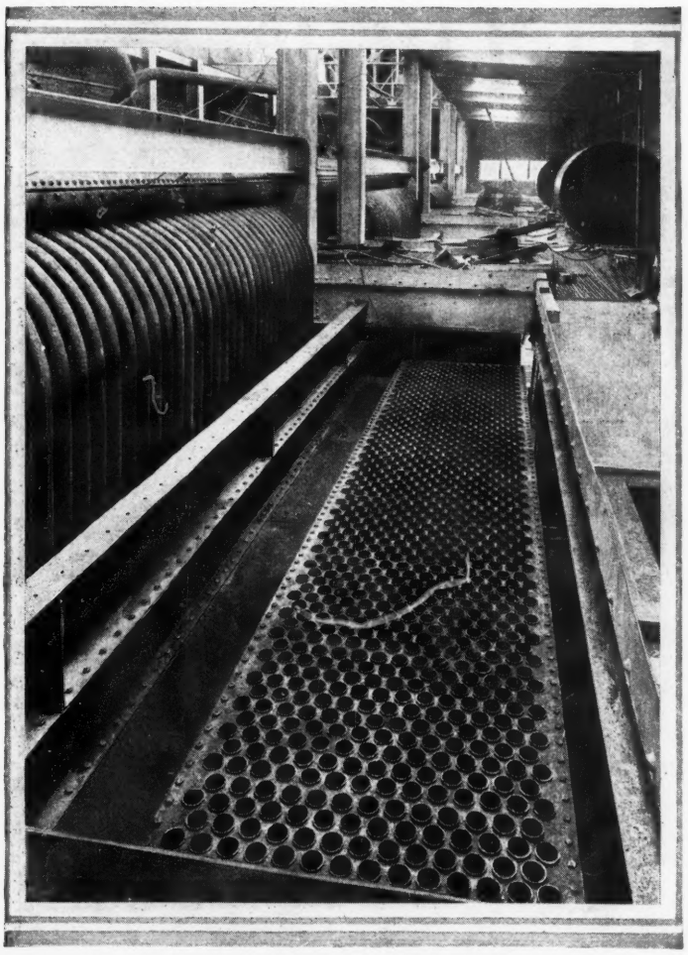


Four duplicate Foster Wheeler tubular air preheaters are shown by the accompanying photographs. They are used with 1340 hp. steam generators and are built into the rear walls of the boilers, replacing brick work.

In this type Foster Wheeler air preheater, gases pass vertically downward thru the tubes. Air flows outside of the tubes, in a direction counter-current to that of the gases. The tubes are spaced to give maximum rate of heat transfer with minimum frictional loss. Baffles are installed, where necessary, to insure distribution of air over the entire heating surface.

AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

FOSTER



Foster Wheeler tubular type air preheater installed in the rear wall of a 1340 hp. steam generator, showing the upper tube sheet. Gases leaving the boiler pass downward thru the tubes. Provision is made for expansion and contraction of the tubes without stressing the tube sheets.

Effective Recovery of Waste Heat

Most efficient generation of steam is assured by reclaiming heat from gases leaving the boiler and returning this heat to the steam generating unit.

Waste heat may be returned to the steam generator by

1. Preheating the feed water, the work of an economizer.
2. By preheating the air used in combustion, the function of an air preheater, or
3. A combination of both.

The equipment that is most economical to install and which will provide the greatest return upon the investment is dependent upon factors which vary for each installation.

Extensive experience in the design and building of air preheaters and economizers—places Foster Wheeler in a position to correctly advise you as to the most economical apparatus for your plant. A study of your requirements will be made and recommendations furnished without obligation.

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165 Broadway, New York, N. Y.

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LINK-BELT Materials Handling and Positive Power Transmission Equipment

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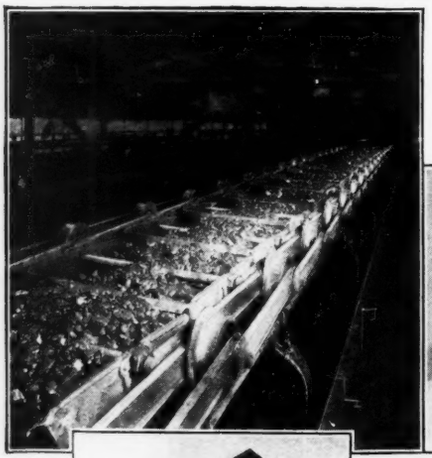
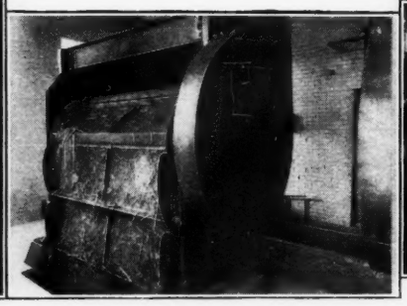
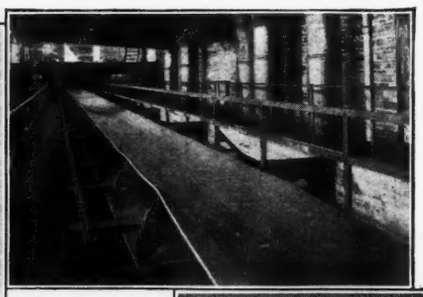
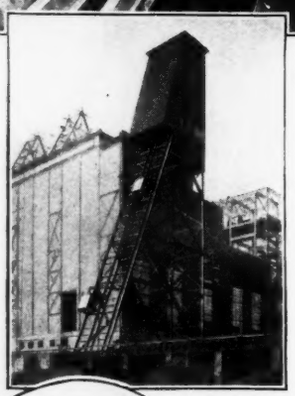
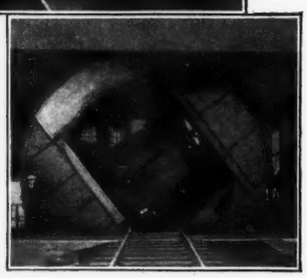






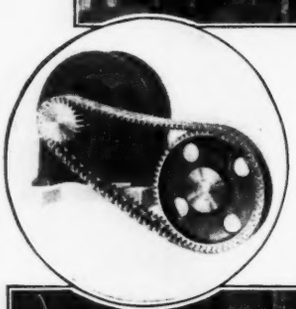


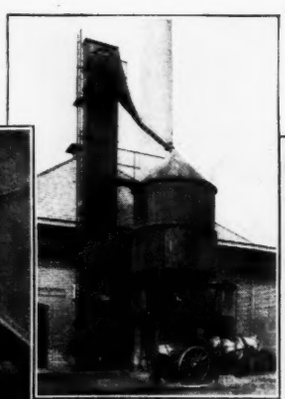


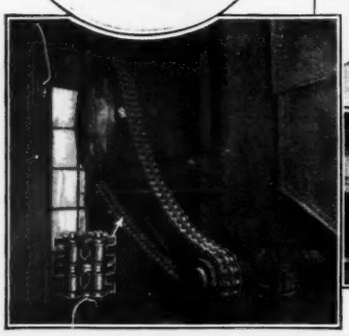
LINK-BELT designs and builds complete in its own plants, conveyors and elevators (belt, flight, screw, bucket; in fact, all approved types), crawler and locomotive cranes, skip hoists, water intake screens, traveling weigh larries, portable loaders and unloaders, chains, wheels, buckets, silent chain drives, roller chain drives, speed reducers, P. I. V. Gear (variable speed transmission), etc.

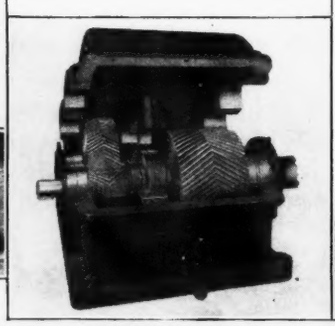
We are therefore in a position to offer unprejudiced recommendations as to the type of elevator, conveyor or power transmitting medium most suitable for existing requirements.

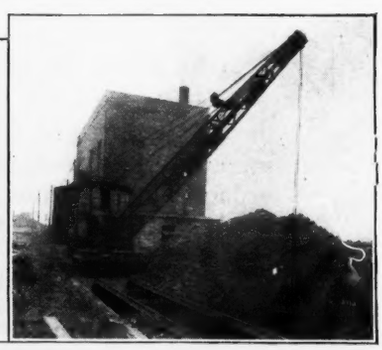
Send for copy of Book 870 showing the scope of the Link-Belt line for industry.











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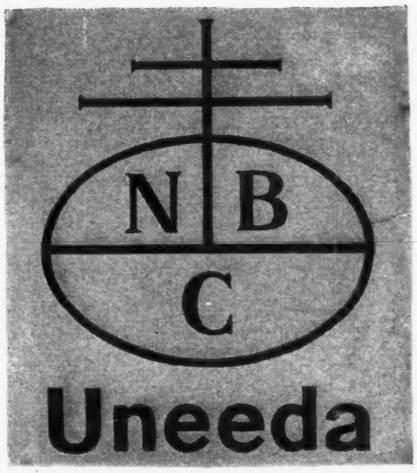
LINK-BELT COMPANY

Leading Manufacturers of Equipment for Handling Materials Mechanically and for the Positive Transmission of Power

CHICAGO, 300 W. Pershing Rd., INDIANAPOLIS, 200 S. Belmont Ave. PHILADELPHIA, 2045 W. Hunting Park Ave. SAN FRANCISCO, 400 Paul Ave.

H. W. Caldwell & Son Co.:—Chicago, New York, Dallas. *Offices in Principal Cities* In Canada—Link-Belt Limited—Toronto; Montreal; Vancouver.



Another

NATIONAL BISCUIT COMPANY plant installs Combustion Engineering Equipment

1917
PITTSBURGH
1919
DETROIT
1921
BUFFALO
1921
CAMBRIDGE
1923
PHILADELPHIA
1924
CHICAGO
1925
MINNEAPOLIS
1926
NEW YORK
1928
BUFFALO
1930
MARSEILLES

Type E Stokers are to be installed in the Marseilles, Ill. plant.

This makes the ninth National Biscuit Company plant to install Combustion Engineering Corporation fuel burning equipment.

Thirteen years ago the first installation was made at the Pittsburgh plant, then Detroit, Buffalo, Cambridge, Philadelphia, Chicago, Minneapolis, New York, Buffalo, and now Marseilles.

The National Biscuit Company, like many of America's leading manufacturers, has for years entrusted to this organization its problem of meeting steam demands.

COMBUSTION ENGINEERING CORPORATION
200 Madison Avenue - - - New York, N. Y.

Boilers - Pulverized Fuel Equipment - Stokers
Water-Cooled Furnaces - Air-Preheaters

Here's the Test Report that is Changing *Bonding Practice* in the Power Field . . . . . .

After a series of tests of Faulkner's Improved Bond, Professor R. M. King of the Ceramic Department of Ohio State University makes the following report:

"I have been making the test you suggested to determine whether your "Bond" showed any weakness during certain stages of heating when used alone and with vegetable compound additions. I made up three sets of 1 in. x 1 in. x 4 in. bars; (1) "Bond" alone, (2) "Bond" with ½ of one per cent dry dextrin, (3) ½ of one per cent dry tannic acid. I made two tests on these bars:

First: I placed these bars across a span wide enough that the ends of the bars had about ½ inch rest at either end. I then placed on top of these bars a weight equal to the weight of the bar. The bars were heated to 1800° F. at a rate of 500 degrees per hour, and allowed to remain at 1800° F. for three hours. The bars were in good shape when removed.

Second: A similar setting was made in a gas furnace, but with the bars holding a weight of five times their own weight. They were heated rapidly with a flame playing on them to 2500° F. and held there for an hour and cooled in one hour, but did not spatter or show any signs of weakness.

These tests confirm my belief that so far as the service quality of your cement is concerned, the use of a vegetable binder has no particular merit.

Further tests showed the fusion point to be 3025° F. and a softening under load equivalent to the best grade of fire brick.

Read this Test...

and write for complete information

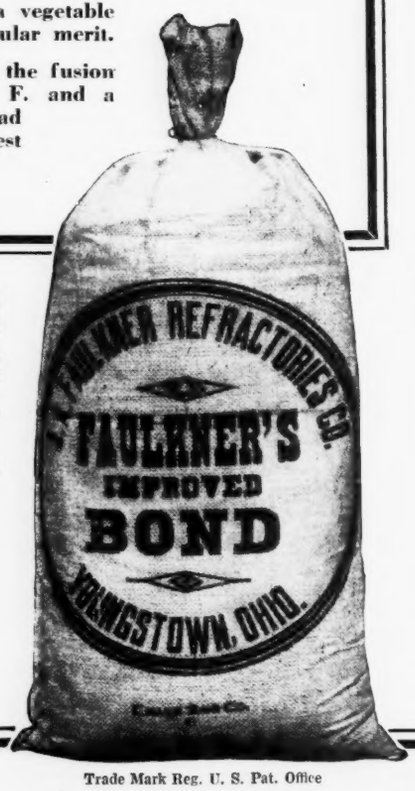
This is the Improved All Temperature Bond that is being used in an increasing number of large and small plants.

NO VEGETABLE BINDER

SETS AT ROOM TEMPERATURE

FOR ALL TEMPERATURES

MORE ECONOMICAL



Trade Mark Reg. U. S. Pat. Office

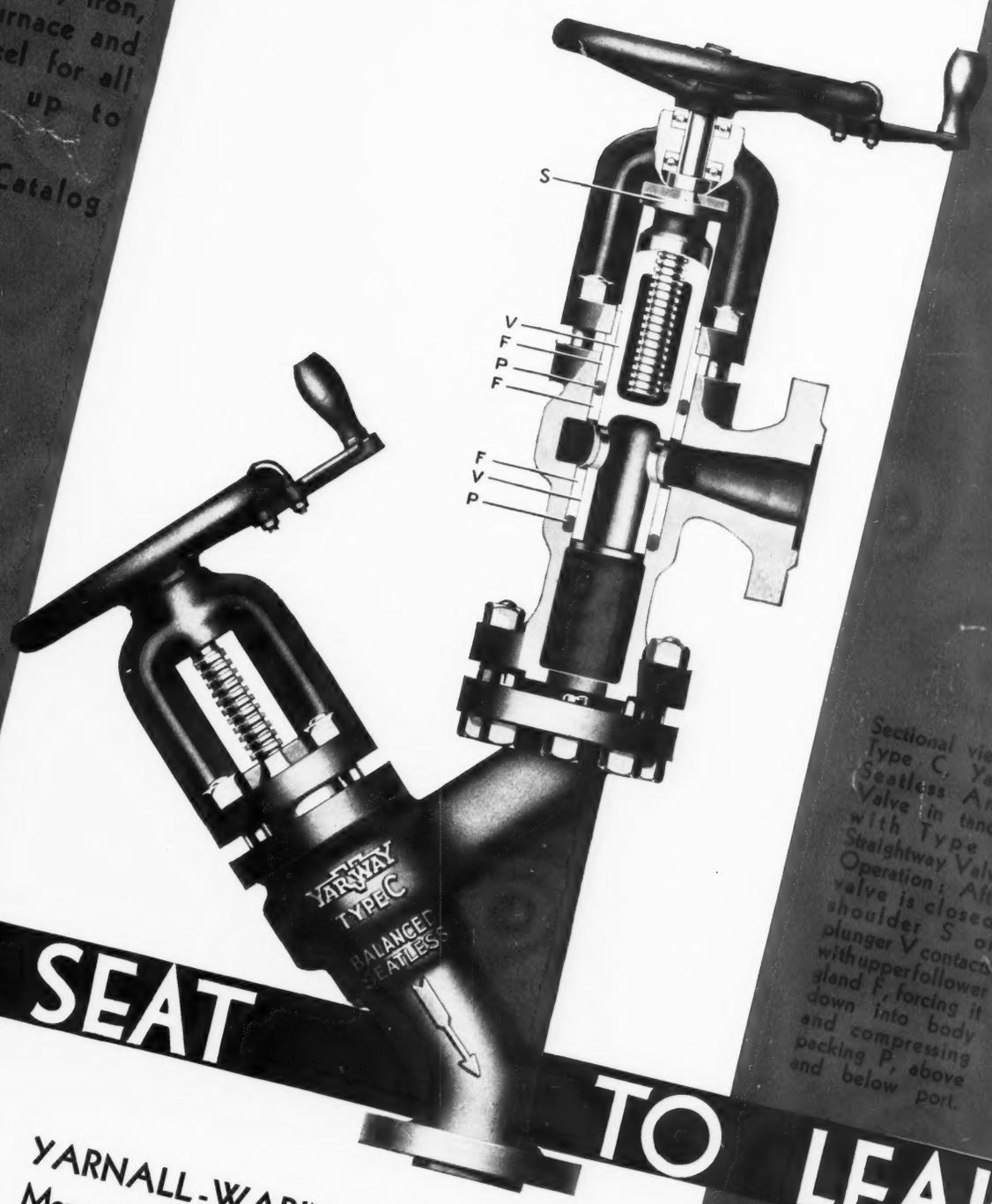
The J.A.FAULKNER REFRACTORIES CO.

523 West Federal St., Youngstown, Ohio

280 Broadway	3232 Frederick Rd.	2700 Weight St.	Blymyer Bldg.	1935 Library Road	Forsyth Bldg.
NEW YORK	BALTIMORE	DETROIT	CINCINNATI	PITTSBURGH	ATLANTA

YARWAY SEATLESS BLOW-OFF VALVES

No Seat to Leak.
Used in over 10,000 plants.
Made of gray iron, electric furnace and forged steel for all pressures up to 2000 lbs.
Send for Catalog B-417.



Sectional view of Type C, Yarway Seatless Angle Valve in tandem with Type C, Straightway Valve. Operation: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packing P, above and below port.

NO SEAT TO LEAK

YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia

YARWAY

FLOATLESS HI-LO ALARM WATER COLUMN AND SE-SURE INCLINED WATER GAGE

Operates on the displacement principle with solid weights—has no floats to become water-logged and useless.

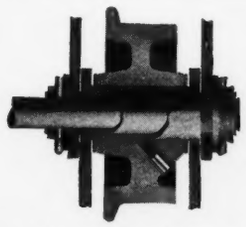
Inclined gage glass for easy reading of high boiler water levels.

Made of grey iron and forged steel in types for low and high pressures.

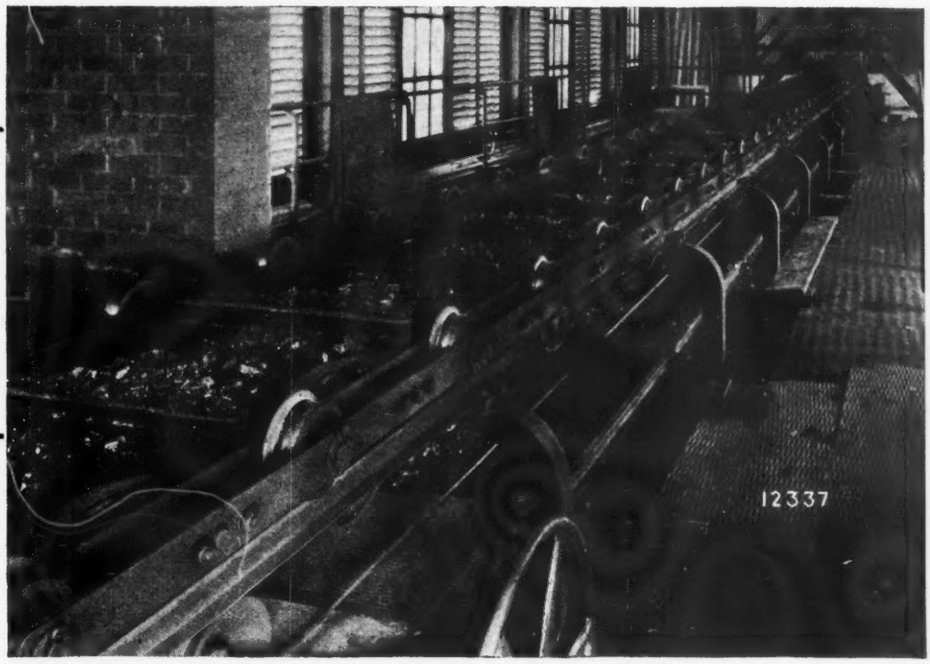
Send for Booklet WG-1802.

NO FLOATS TO SINK

YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia



All chain wear is taken on double, glass hard bushings —readily replaceable.



Where Breakdowns Mean More than a Repair Bill they Use the JEFFREY PIVOTED BUCKET

Those plants where interference with the flow of coal to boilers is too disastrous in consequence to be even contemplated are very likely to have Jeffrey Pivoted Bucket Carriers.

If breakdown brings in its train the costly shutdown of other departments —the failure to give service when service is demanded—then you too need the Jeffrey Pivoted Bucket Carrier.

The Jeffrey Pivoted Bucket Carriers are as near breakdown proof as they can be made. Every part is double guarded against failure.

Unique Chain construction puts all wear on double, glass hard bushings. Tough malleable buckets, rollers and tripping cams of tough, hard chilled iron—strength everywhere.

The Pivoted Bucket Carrier will elevate your coal, distribute it to bunkers or storage, reclaim from storage, and carry out the ashes—all in one unit. *Write for Bulletin No. 210-H which describes the dean of conveyors.*

The Jeffrey Manufacturing Company
932-99 North Fourth St., Columbus, Ohio

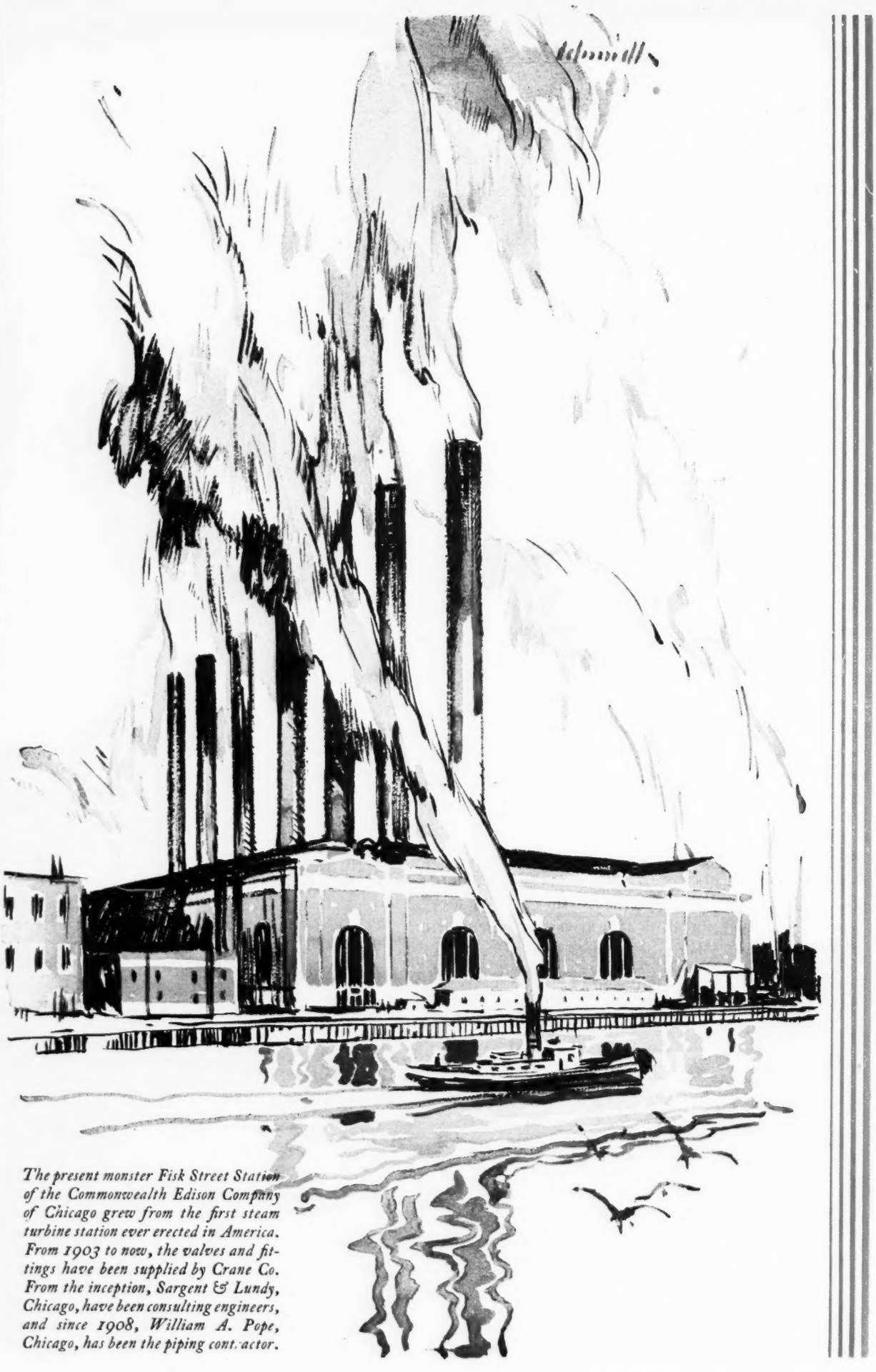
New York Buffalo | Utica Rochester, N. Y. | Philadelphia Pittsburgh | Scranton, Pa. Boston | Cincinnati Cleveland | Detroit Chicago | Charleston, W. Va. Milwaukee | St. Louis Denver | Salt Lake City Birmingham | Houston

Jeffrey Manufacturing Company, Ltd. Head Office and Works, Montreal. Branch Office, Toronto

JEFFREY
MATERIAL HANDLING EQUIPMENT

Jeffrey Equipment for Handling Coal and Ashes

- Pivoted Bucket Carrier
- V-Bucket, Scraper, Belt, Apron, Spiral, Drag Chain, and other types of Conveyors
- Bucket Elevators
- Skip Hoists
- Weigh Larries
- Hoppers and Bins
- Reciprocating and Apron Feeders
- Crushers and Pulverizers



The present monster Fisk Street Station of the Commonwealth Edison Company of Chicago grew from the first steam turbine station ever erected in America. From 1903 to now, the valves and fittings have been supplied by Crane Co. From the inception, Sargent & Lundy, Chicago, have been consulting engineers, and since 1908, William A. Pope, Chicago, has been the piping contractor.

When a power plant builder took all the risk

On the Fisk Street Power Station of the Commonwealth Edison Company of Chicago is a tablet which reads:

"The first steam turbine station in America . . . placed in operation Oct. 2, 1903, to serve Chicago with electricity. To commemorate the pioneering which revolutionized central station practice, this tablet was erected on the 25th anniversary, 1928."

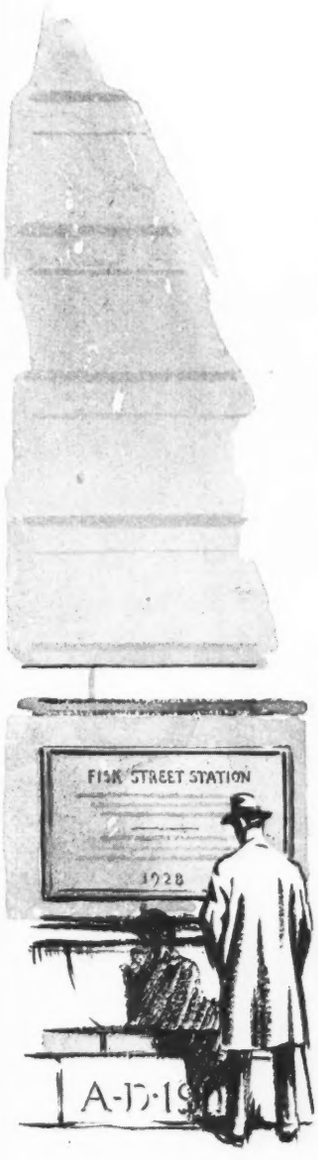
In 1903, the maximum power load for the Chicago district was 34,000 kilowatts. Now, it is 1,252,000 kilowatts. In this first turbine station, the valves and fittings were supplied by Crane Co. For every enlargement of it since, the valves and fittings were supplied by Crane Co.

"When the station was proposed, Mr. Coffin, president of the General Electric Co. and his engineers were not particularly anxious to take the risk of a 5000 kilowatt unit," said Samuel Insull, president of the Commonwealth Edison Company, at ceremonies unveiling the commemorative tablet. "We told them: 'We will take the risk. If the plant is not successful, we will make no claim against you. All you have to do is to take the apparatus out and throw it on the junk pile.'" Whether it was successful is best told by the present development of the power industry.

When this station was built, no valve maker could say with scientific certainty that his materials were without service and safety risks. Now, thanks to such authoritative research and tests as Crane laboratories and foundries have conducted, Crane Co. can say with as near certainty as is humanly possible: "Under the ratings for which we recommend our materials, there is no risk."

If you are planning a new pioneering installation, or simply seeking to modernize an old one economically, Crane piping materials will help. There are Crane specialists in piping and piping problems placed at strategic points throughout the country to give you the benefit of Crane experience.

1855
SEVENTY-FIFTH
ANNIVERSARY
1930

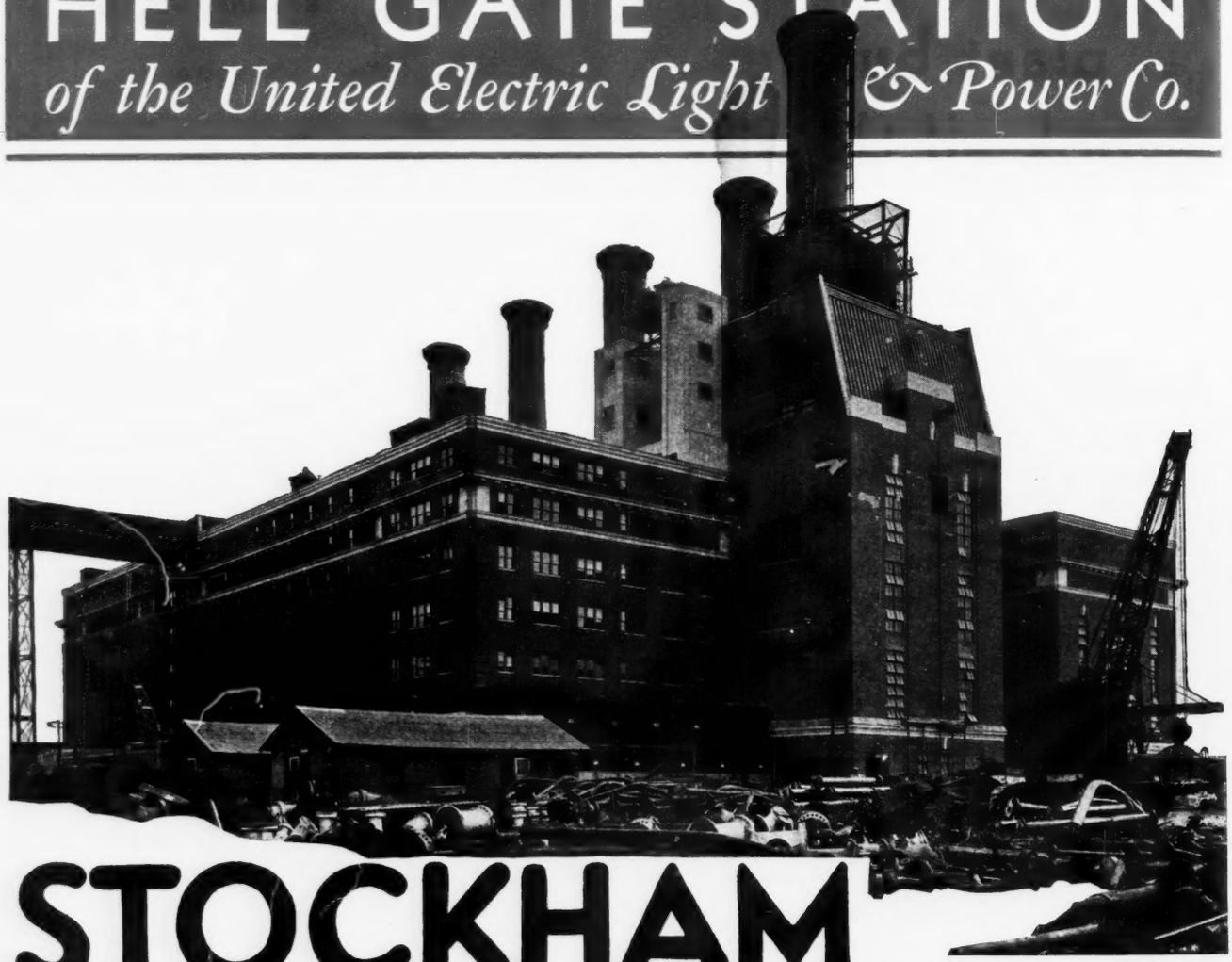


CRANE

PIPING MATERIALS TO CONVEY AND CONTROL STEAM, LIQUIDS, OIL, GAS, CHEMICALS

GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO
NEW YORK OFFICES: 23 W. 44TH STREET
Branches and Sales Offices in One Hundred and Ninety-six Cities

HELL GATE STATION
of the United Electric Light & Power Co.



STOCKHAM FITTINGS

WORLD'S largest power plant—and Stockham Electric Cast Steel Fittings for its high pressure work on the new 2,000,000 pound boiler extension and on the re-building program of nine boilers during the past two years. Stockham dependability in meeting specifications is not by chance, but a natural result of the care that accompanies every stage in Stockham production. Large job or small, ample stocks and vast plant capacity insure speedy delivery of any of the over 12,000 different fitting patterns in the Stockham Line. Complete catalogue on request.

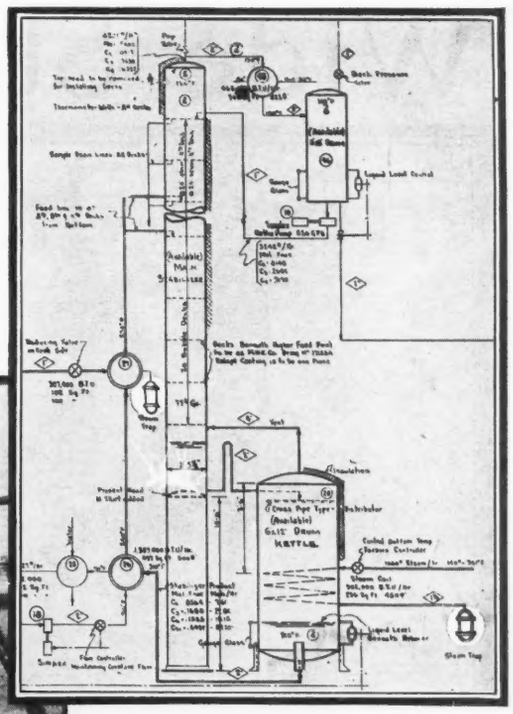
STOCKHAM PIPE & FITTINGS CO., BIRMINGHAM, ALA.

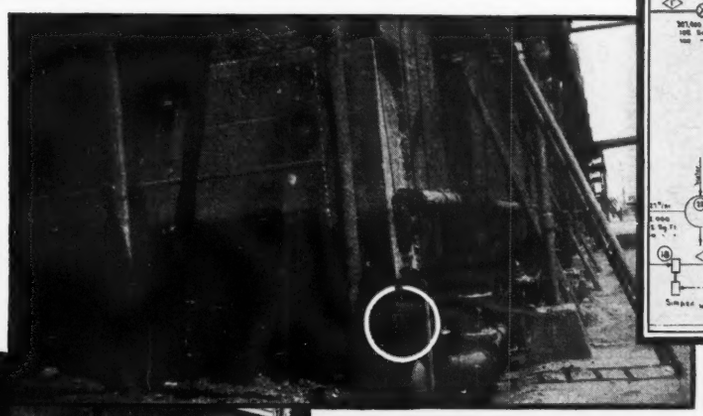
STOCKS IN: BOSTON NEW YORK CHICAGO HOUSTON LOS ANGELES

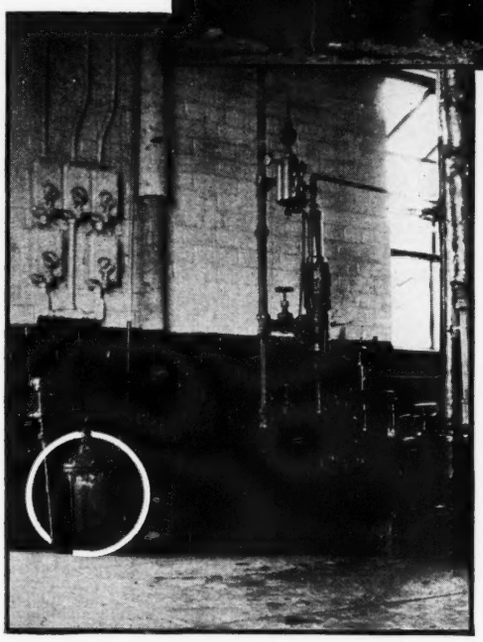
There is a Stockham Fitting for every pipe line use

CAST IRON	MALLEABLE	ELECTRIC CAST STEEL
Screwed • Flanged	*Standard • Extra Heavy*	*Screwed*
Drainage	*Hydraulic • Oil Country*	*Flanged*
Sprinkler	*Fire Line • Railroad 300 lb.*	

Why refinery engineers chose ARMSTRONGS







THE photographs show a few of the 25 or so Armstrong Inverted Bucket Traps used by the Simms Oil Company in their plant at Dallas, Texas.

The line-drawing represents the hook-up of traps on main stabilizer equipment in the absorption and stabilization plant of the refinery. One trap drains a kettle at 140 lbs. pressure; another the preheater at 50 lbs. pressure (in a representative cycle).

The Refining Engineers, Inc., of Kansas City chose Armstrong traps for the above plant because of their proved outstanding performance. They cannot airbind . . . . do not clog on scum or sediment . . . . have large capacity with small size (they are supported by connecting pipes) . . . . do not wire-draw (they have chrome steel valves) . . . . operate positively and efficiently for years without attention.

Armstrong performance has been so consistent in both power and process service that we do not hesitate to offer you as many traps as desired on 90 days' free trial, without obligating you in any way. At the end of the test period return the traps at our expense. The coupon is for your convenience in taking advantage of this offer.

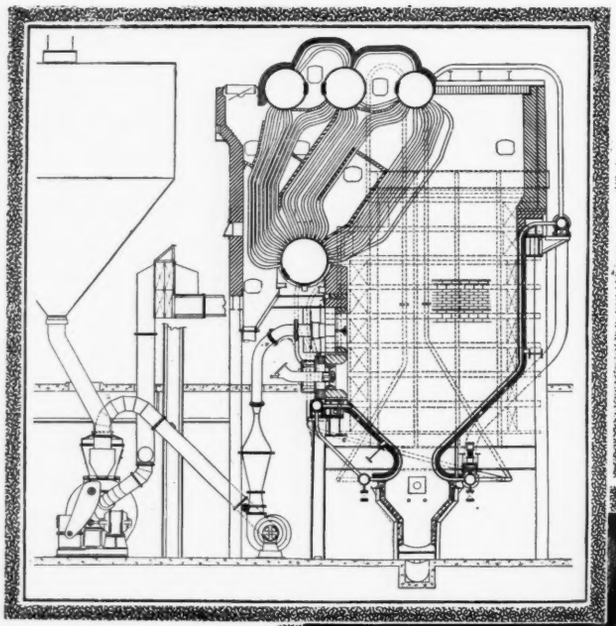
Send the Coupon!

ARMSTRONG
MACHINE WORKS
Three Rivers, Michigan
District Representatives in 42 Cities

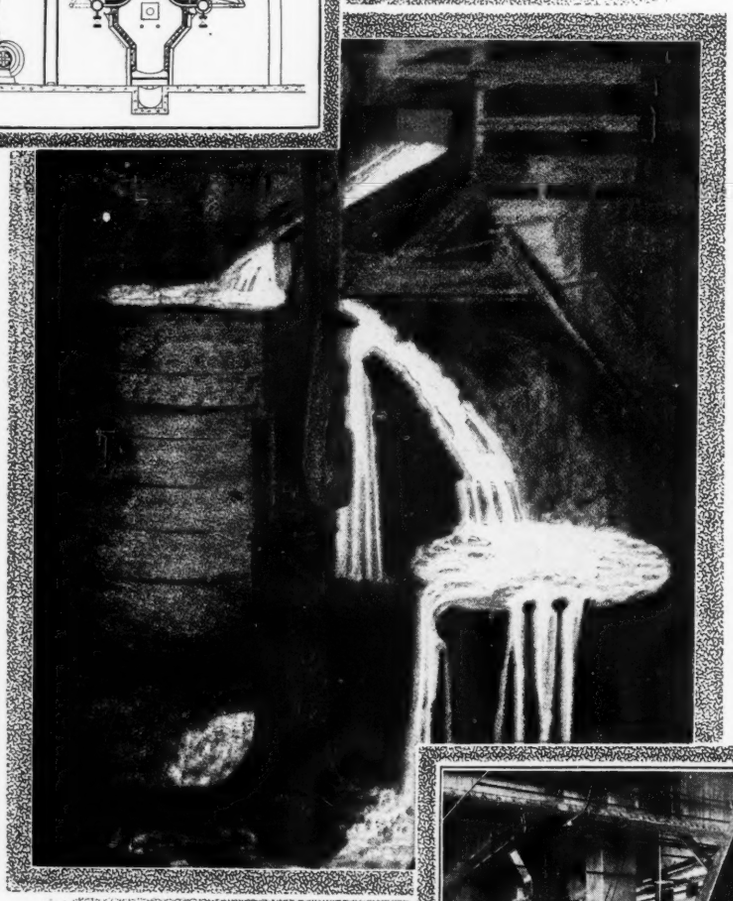
To (Name) (Firm)
(Position) (City) (State)
(Street)
For (Size and make of machine)
Steam Pressure (Max.)
Size of Pipe
☐ *Send Catalog* *from*
ARMSTRONG MACHINE WORKS
THREE RIVERS, MICH.
P12-30Gray

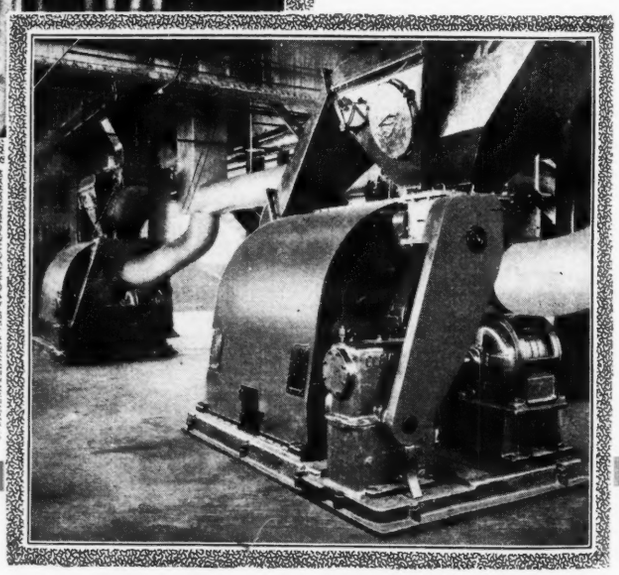
Fill in and Mail For 90 Day Test

Wide Steam Demand



Arrangement of the boiler and Fuller Lehigh Equipment at the Eddystone, Pa., plant of the General Steel Castings Corporation. Bailey Water-Cooled Furnace Construction is used for the rear walls and hopper bottoms of the furnace. Each boiler generates 71,800 pounds of steam per hour at 150 lbs. per sq. in. pressure.





The two large capacity Fuller-Bonnot Pulverizers at Eddystone.

met with Pulverized-Coal Firing

WINTER PEAK OF 125,000 POUNDS PER HOUR DROPS TO 4200 POUNDS IN SUMMER

AT the Eddystone, Pa., plant of the General Steel Castings Corporation, steam is used for oil atomization in the open-hearth and annealing furnaces and for factory heating. The demand for steam on extremely cold days in winter may reach 125,000 pounds per hour. The load, however, drops to 4200 pounds per hour during the summer months.

A boiler plant of great flexibility is needed to meet this wide variation in load. The boilers must operate continuously at high rating and efficiency during the winter and work satisfactorily at a fraction of normal rating in summer.

The Fuller Lehigh Direct-Fired Pulverized-Coal System and Bailey Water-Cooled Hopper-Bottom Furnaces were selected for the two Stirling Boilers as the most suitable equipment to meet these conditions. Each boiler is served by one large pulverizer for high-capacity operation and a small mill is used with either boiler at light loads.

Furthermore, the normal operating force at this plant consists of two men—a shift engineer and a helper. The pulverizing equipment is controlled by push buttons, thus exemplifying the high degree of flexibility that can be incorporated in the system.

Write for a copy of Reprint 5-78. It contains full particulars of this interesting installation.

FULLER LEHIGH COMPANY
A Babcock & Wilcox Organization
FULLERTON, PENNA.

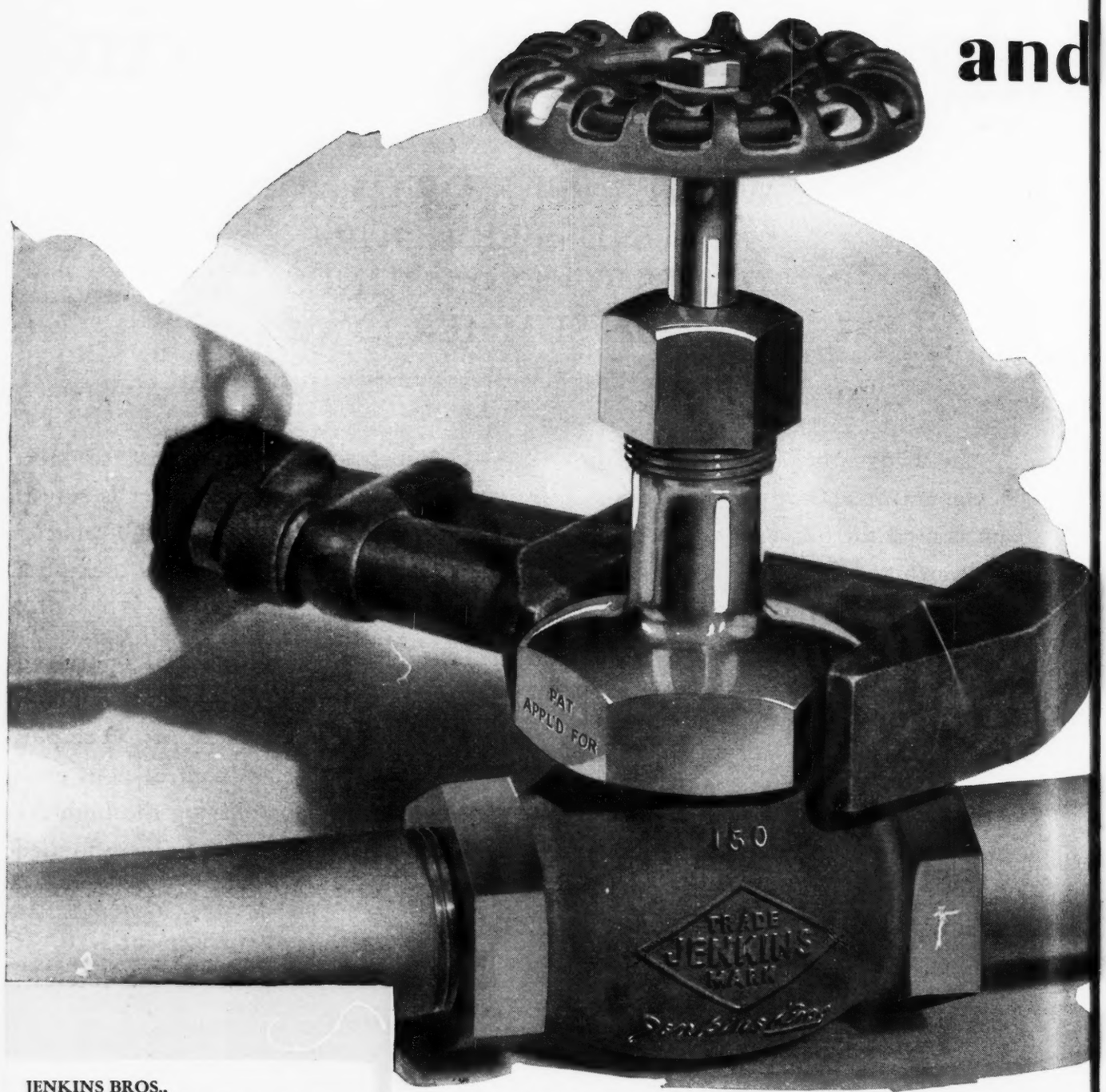
212-T

FULLER LEHIGH

PULVERIZED-COAL EQUIPMENT ~ WATER-COOLED FURNACE WALLS

This valve can

and



Jenkins Valves are always marked with the "Diamond"

JENKINS BROS.,
80 White Street, New York, N. Y.
Please send Bulletin 141 on Jenkins Standard Bronze Valves with one-piece screw-over bonnets to

Name.....

Address.....

.....

FIG. 106-A, SCREWED, JENKINS STANDARD BRONZE GLOBE VALVE, *with one-piece screw-over bonnet, and slip-on stay-on disc holder. For 150 lbs. steam working pressure, or 250 lbs. oil, water, gas working pressure.*

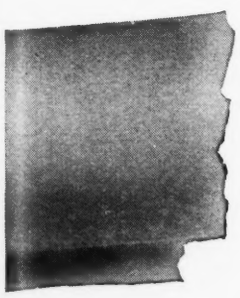
be *easily* taken apart, re-assembled repeatedly,

without distorting the bonnet!

HERE is Fig. 106-A, Jenkins Standard Bronze Globe Valve. The bonnet is made in *one sturdy piece of bronze.* Great strength is the result. Trimmings are interchangeable between globe and angle valves.

This valve can be easily taken apart and re-assembled repeatedly, without danger of distorting or springing the bonnet!

Then, there is the unique slip-on stay-on disc holder that does not fall off the spindle. In a few simple, quick operations, you can change the disc. Remove the one-piece bonnet . . . slip off the old disc and holder . . . slip on the new disc and holder . . . and replace the bonnet.



These new valves are obtainable, through your supply house, in globe. angle, cross and check types, screwed or flanged. Use the coupon for further information.

JENKINS BROS.

80 White St. New York, N. Y. — 524 Atlantic Ave. Boston, Mass. — 133 No. Seventh St. Philadelphia, Pa.
646 Wash. Blvd., Chicago, Ill.
1121 No. San Jacinto, Houston, Texas
JENKINS BROS., Limited
Montreal, Canada — London, England
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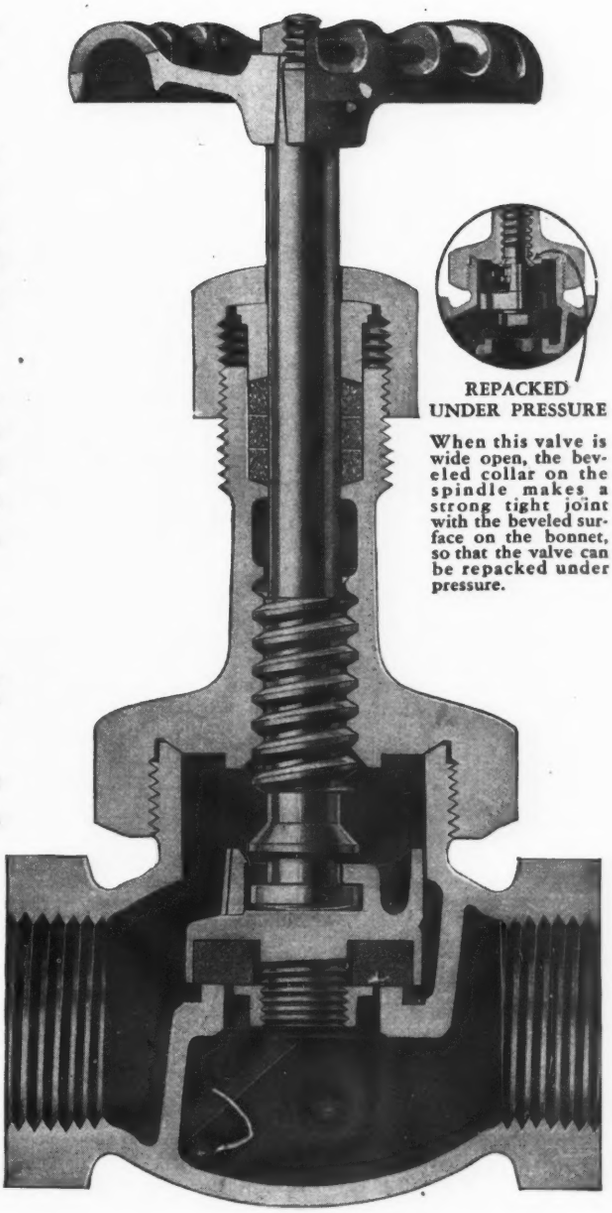
Bridgeport, Conn. — Elizabeth, N. J. — Montreal, Canada

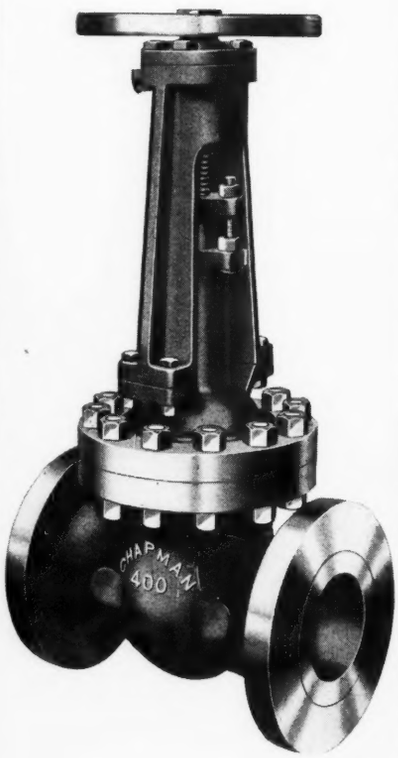


REPACKED UNDER PRESSURE

When this valve is wide open, the beveled collar on the spindle makes a strong tight joint with the beveled surface on the bonnet, so that the valve can be repacked under pressure.

Jenkins
VALVES
Since 1864

and now——



Chapman Electric Chrome Tungsten Valves and Fittings are made for working pressures of 250, 400, 600, 900 and 1350 lb. and total temperatures up to 1000 deg. F.

Send for descriptive literature.

A METALLURGICAL ACH

CHAPMAN

Electric Chrome Tungsten Steel

VALVES and FITTINGS...

A new development by Chapman—valves and fittings made from the New Chapman Electric Chrome Tungsten Steel—an alloy of exceptional characteristics that adapt it to the most strenuous operating conditions.

Chapman Electric Chrome Tungsten Steel Valves with Nitrided Steel, Stainless Steel, Monel or Davis Metal trim are recommended for all extreme conditions in pressure and temperature in modern central stations, industrial plants, oil refineries, chemical factories, etc.

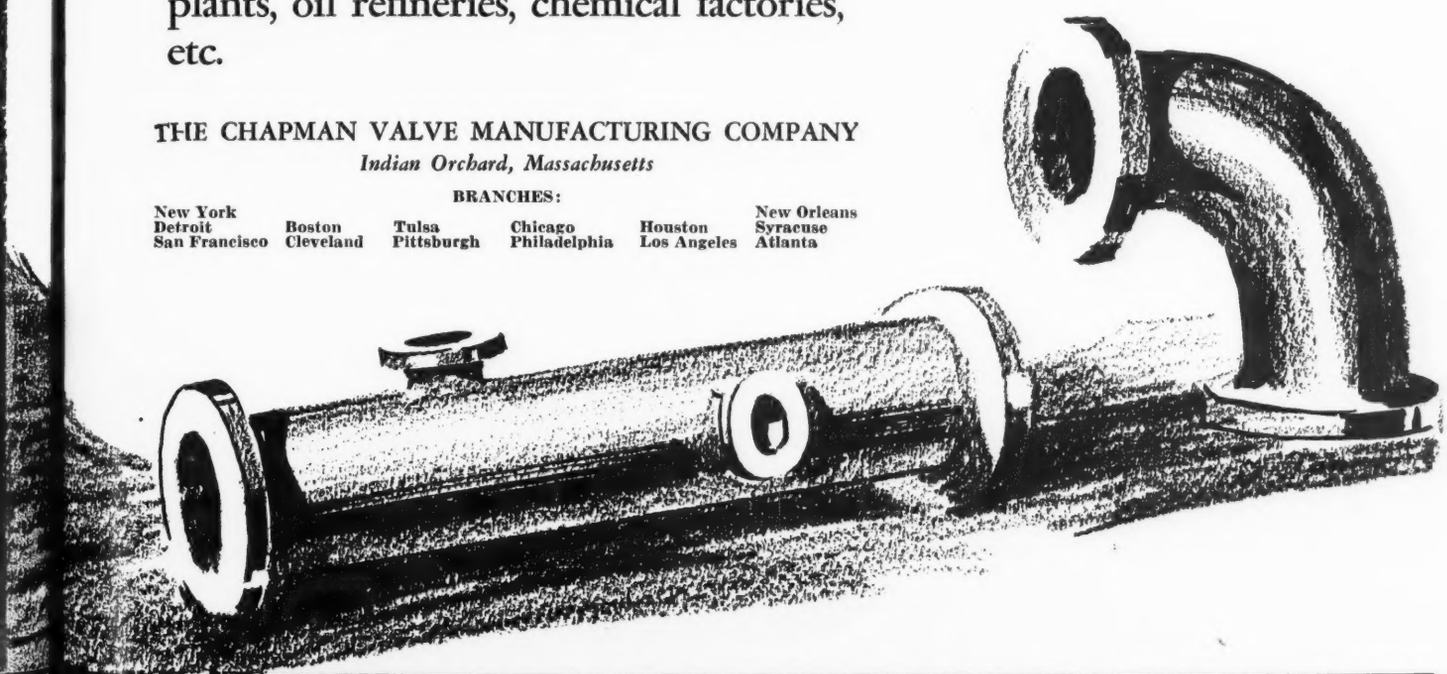
Electric Chrome Tungsten Steel
Physical Properties of Chapman

Tensile Strength—	120,000 lb. per sq. in.
Yield Point—	100,000 lb. per sq. in.
Elongation in 2"—	18 per cent
Reduction of Area—	50 per cent
Brinell Hardness—	225-250

THE CHAPMAN VALVE MANUFACTURING COMPANY
Indian Orchard, Massachusetts

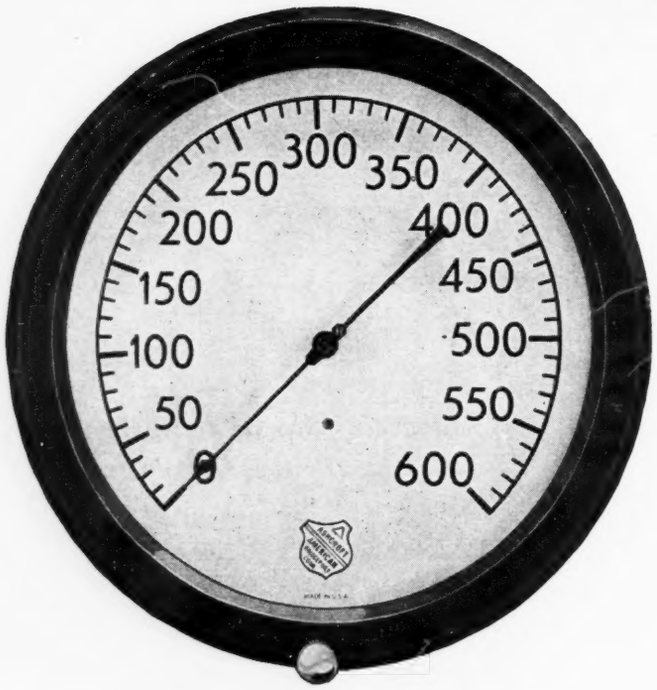
BRANCHES:

New York, Boston, Tulsa, Chicago, Houston, New Orleans
Detroit, Cleveland, Pittsburgh, Philadelphia, Los Angeles, Syracuse
San Francisco, Atlanta



HIEVEMENT BY CHAPMAN

The NITRA



The Ashcroft American DURAGAUGE is made in sizes from 4½" to 16", for all pressures up to 5,000 lbs., in Wall Mounted case, Flush Mounted, and Flush Mounted Illuminated cases for gauge boards.

SIX months ago the nitralloy movement of one of our new Ashcroft American DURAGAUGES was connected to a small compressed air hammer vibrating at about 1500 cycles per minute. At the same time the movement of a commercial gauge was attached to the same hammer in the same way.

The hammer has been vibrating 24 hours a day ever since. The nitralloy movement still shows no sign of wear, but the other gauge movement has been replaced suc-

CONSOLIDATED
ASHCROFT
HANCOCK

Specify Catalogs Desired

American Dial Thermometers	G-32	American Temperature Controllers	R-32
American Glass Thermometers	F-32	American Recording Gauges	E-32
American Recording Thermometers	H-32	American Draft Gauges	B-32
Ashcroft American Gauges	A-32	American Gauge Testers	D-32

LLOY movement

. . . of *this* Gauge . . . outlasts a Hundred others

cessively by a hundred others . . . including movements taken from every make of gauge. The average length of life of an ordinary bronze movement was 75 minutes under this severe test. By that time the teeth were worn almost bare.

These movements have, in every instance, literally gone to pieces before being replaced . . . but the new Ashcroft American nitralloy movement remains in perfect condition.

Frankly, we don't know how long it *will* last!

But consider what this means to you . . . here at last is a gauge with a practically indestructible movement; a gauge that is made to last forever.

The Ashcroft American DURAGAUGE is unconditionally guaranteed for five years, and to be accurate within one-half of 1% over the entire scale range. Such a gauge could only be produced by a Company with a background of eighty years of gauge manufacturing experience. Write today and get the complete story.

CONSOLIDATED ASHCROFT HANCOCK CO., INC.
Bridgeport, Conn.
Subsidiary of Manning, Maxwell & Moore, Inc.

ASHCROFT AMERICAN DURAGAUGE

American Tachometers	J-32	Hancock Bronze Valves	WB-32
Ashcroft Power Control Valves	M-32	Hancock Cast Steel Valves	WA-32
Consolidated American Safety and Relief Valves	Z-32	Hancock Forged Steel Valves	W-32
		American Dairy Instruments	Q-32

DISCS AND SEATS

Reversible.. Regrindable Renewable..

In those few words you have the secret of Hovalco Blow-Off Valve success. In fact you have the main reasons for the economical blow-off service that so many plants are now enjoying.

It is a very simple matter to regrind, reverse or renew the disc and seat of the Hovalco valve—no special tools are required—nor is it an expensive operation. Renewal is seldom necessary because both are made of Monel Metal. The cost of both disc and seat is low. Another advantage—repairs can be made while boiler is under pressure.

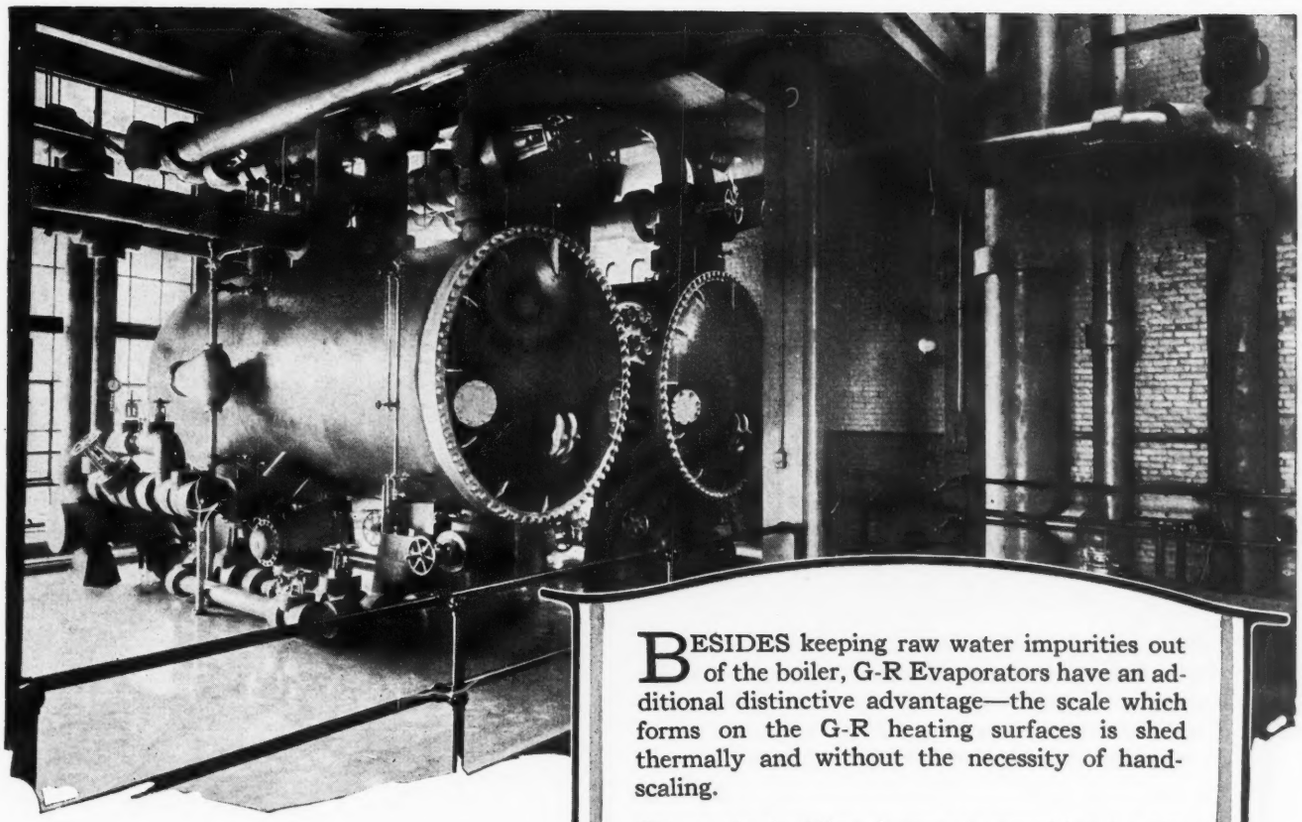
The Hovalco Angle Valve when used in combination with a Homestead Quarter-Turn Valve meets the requirements of all state boiler laws and the A.S.M.E. code.

Cost records of users substantiate our statements and show that maintenance costs over a long period of years are lower than those for former equipment.

Our catalog gives complete construction details. Tell us where to send your copy.

HOMESTEAD VALVE MFG. CO.

BOX 218-A **CORAOPOLIS, PENNSYLVANIA**



The turn of a valve *cracks off the toughest scale from G-R Evaporator Tubes*

BESIDES keeping raw water impurities out of the boiler, G-R Evaporators have an additional distinctive advantage—the scale which forms on the G-R heating surfaces is shed thermally and without the necessity of hand-scaling.

This scale-shedding feature is provided by the special patented construction of the tubes or coils in G-R Evaporators. Changes in temperature cause varying distortion of the heating surface which cracks up and breaks off scale accumulation. Even the most tenacious scale is readily removed by blowing down the evaporator, filling with cold water and then opening the steam supply so as to heat the tubes or coils suddenly, with corresponding quick distortion.

The benefits of distilled boiler feed make-up and the many special advantages of G-R Evaporators are fully described in a new bulletin which will be sent on request.

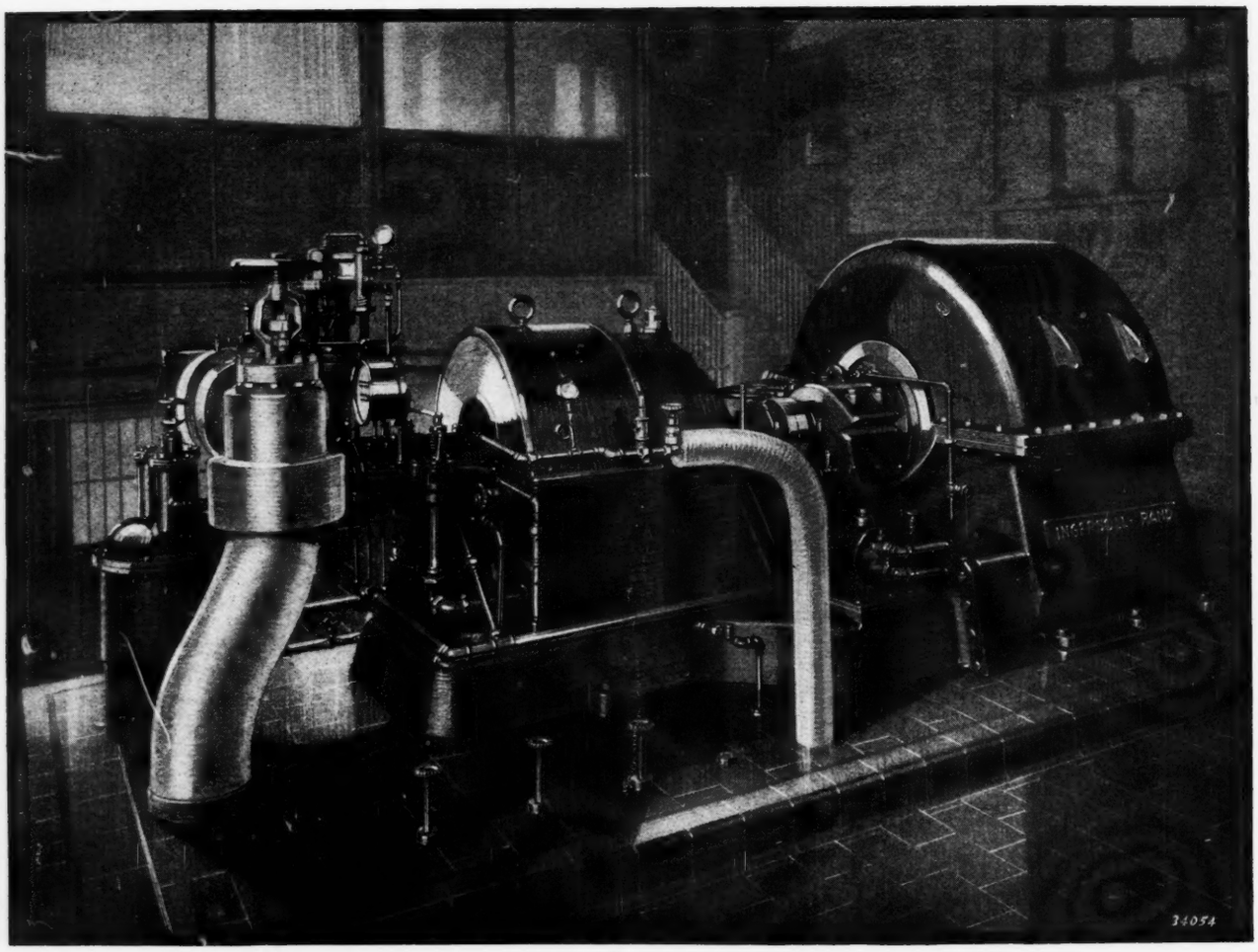
The Griscom-Russell Co., 285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
Boston	Cleveland	New Orleans	Los Angeles
Buffalo	Massillon	Houston	Seattle
Rochester	Detroit	Dallas	Portland
Pittsburgh	Milwaukee	Charlotte	Denver
Cincinnati	Minneapolis	Atlanta	Tulsa
Indianapolis	Kansas City	Memphis	

For Canada: Riley Engineering & Supply Company, Ltd., Toronto

Griscom-Russell

Heat Transfer Apparatus



BACKED BY RESEARCH AND EXPERIENCE

The turbine-driven centrifugal gas booster shown above is one of 18 Ingersoll-Rand turbo units now successfully operating in several plants of a public utility company in a large Middle Western city. It has a capacity of 550,000 cu. ft. of gas per hour at 6 pounds discharge pressure. It is equipped with constant pressure regulation.

Ingersoll-Rand Company has supplied centrifugal blowers to leading gas companies in every section of the country. Each unit is a product of an experience that goes back nearly 20 years. This experience qualifies the engineering staff to solve any problem in regulation and to supply the most suitable system to meet each case.

A modern research department is constantly on guard to see that the most suitable materials are employed throughout. Rigid specifications are enforced in every detail of manufacture, and a system of thorough inspection eliminates defects and insures accuracy of parts. Every care is exercised to secure correct alignment and proper clearances. Exhaustive shop tests are run on every unit before it is passed for shipment.

INGERSOLL-RAND COMPANY » 11 Broadway « New York City

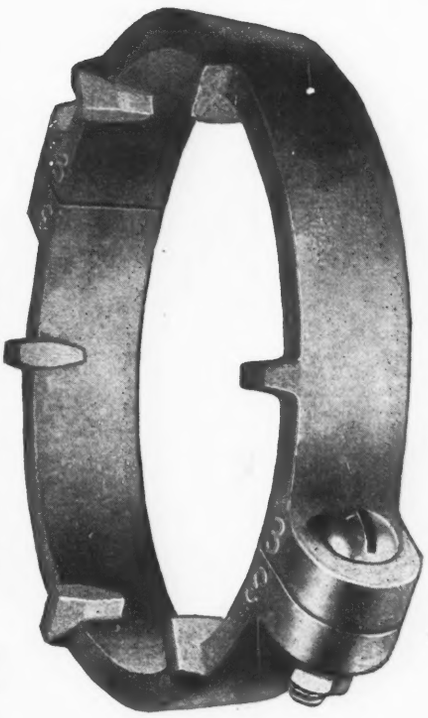
Branches or distributors in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

72-T

Ingersoll-Rand

DON'T LET LEAKS AT PIPE JOINTS GIVE YOU A BAD REPUTATION

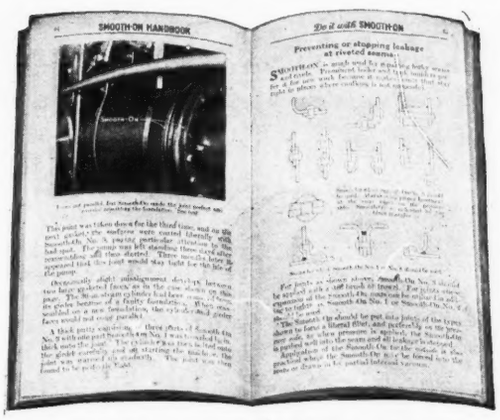


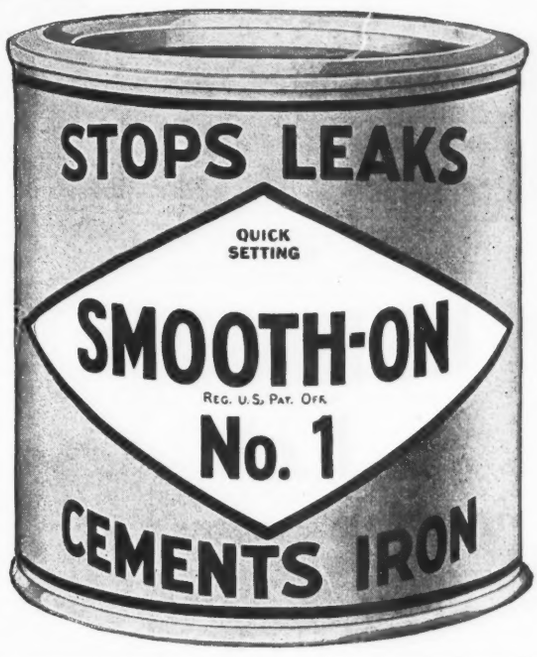
IF leakage at pipe joints streaks the wall, discolors the pipe covering, causes some of it to loosen and fall off, and keeps the floor wet and mussy, your superior is justified in believing that you let more serious faults exist.

Any Engineer can stop leaks at threaded joints quickly, perfectly and permanently by applying SMOOTH-ON No. 1 in a SMOOTH-ON Clamp. The job is done in a few minutes, at small cost, without the delay of taking down the line and remaking the joints. When the pipe covering is replaced the repair cannot be seen.

SMOOTH-ON Clamps are excellent for repairing leaks at any pipe-thread joint on steam, gas, air, oil, ammonia, alkali and water lines. The SMOOTH-ON Handbook tells you how to place and fill the clamp and how to make about 200 other simple, practical and profitable repairs with SMOOTH-ON.

If you would be prepared for stopping pipe leaks and for making other quick repairs at breaks, joints, open seams, etc., keep a supply of SMOOTH-ON No. 1 and a few SMOOTH-ON Clamps of various sizes in your store room, and get a copy of the SMOOTH-ON Handbook for your desk.





Mail the coupon for the SMOOTH-ON Handbook and get SMOOTH-ON Clamps in pipe sizes from ⅜-in. to 12-in. and SMOOTH-ON No. 1 in 1-lb. and 5-lb. cans or 25-lb. or 100-lb. kegs. If your dealer can't supply you, write to us.

THE SMOOTH-ON HANDBOOK FREE if you return the coupon

THERE are seven SMOOTH-ON cements, each for specific uses, and all explained and illustrated in the 136-page SMOOTH-ON Handbook, 21st Edition.

If you want to learn about possibilities and savings beyond your fondest expectations, get a copy of this book and *follow its advice.*

The directions and diagrams will post you well on SMOOTH-ON, where to use each kind, how to apply for best results, and what to expect from the finished job, based upon pictures and data, from over 100 typical applications.

SMOOTH-ON MFG. CO.,
Dept. 30, 570 Communipaw Ave., Jersey City, N. J.

Please send copy of the SMOOTH-ON HANDBOOK, 21st Edition.

Name .....

Address .....

.....

12-30-30

Do it with **SMOOTH-ON**

AGAIN ... CONNERY CONSTRUCTION

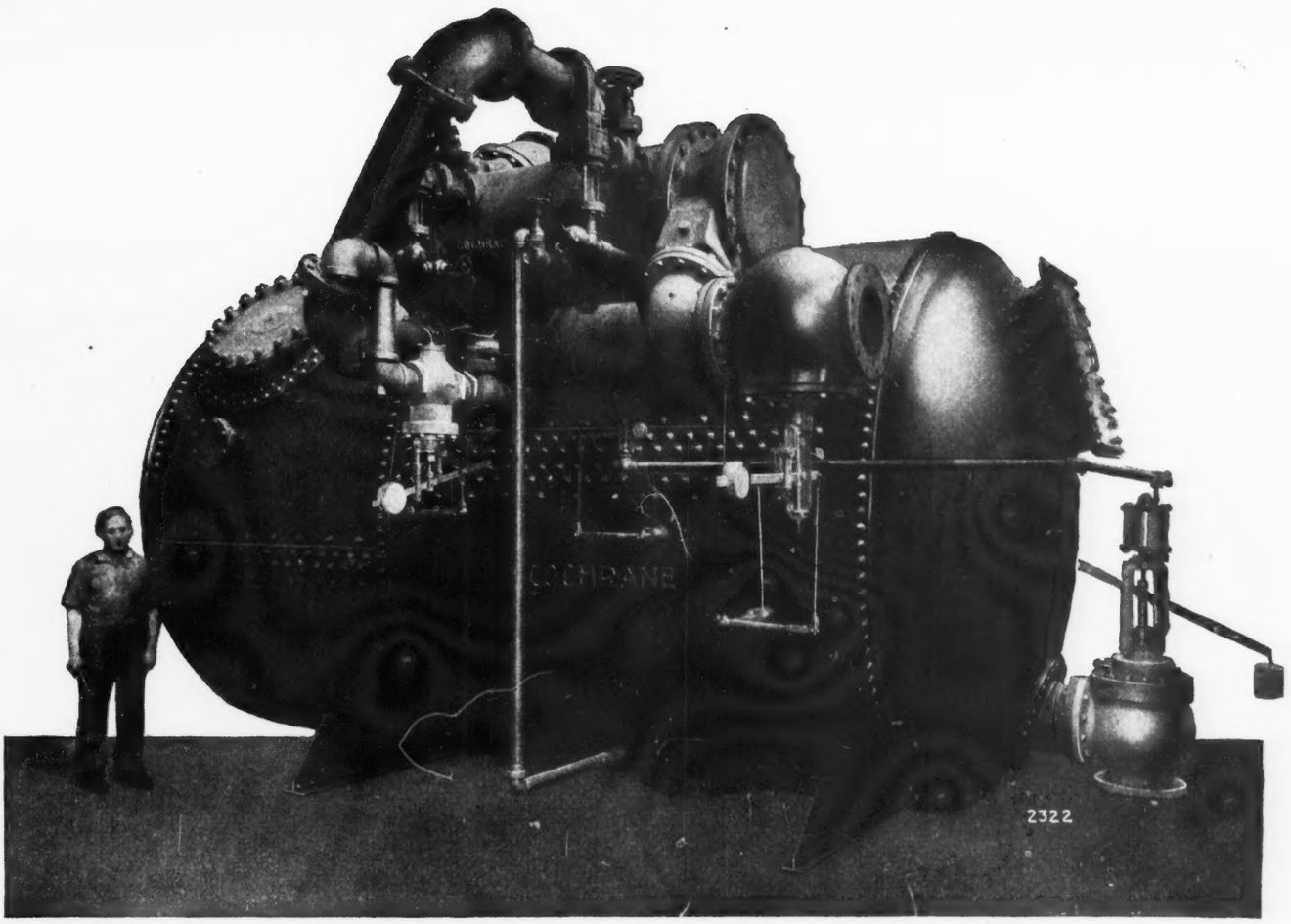
Here's more Connery Construction—at Viscose Co. This is the third installation for these folks, at the new Lewiston, Pa., plant. Connery Construction went into the plants at Meadville, Pa., and at Parkersburg, W. Va., also. Looks good! Is good! Built to last, with expansion V's cold pressed into the sheets, with corners and laps electrically welded, with *flexibility* to care for all the expansion and contraction that can ever occur and yet absolutely tight . . . neither can gases leak out nor water leak in.

For quality in materials and construction, for flues, ducts, breechings, uptakes, make your specifications read "Connery Construction." Let us tell you more about it.

CONNERY & COMPANY, INC.

Second and Luzerne Sts., Philadelphia, Pa.

Branch Office, New York



805,400 Lbs. per hour of non-rusting water

THIS Cochrane Deaerating Heater was supplied to a large central station system to heat and deaerate 805,400 pounds of water per hour. The steam used to heat and deaerate the water is bled from the main turbine unit and the heater has been designed for pressures ranging from a vacuum up to 75 lbs. per sq. in. gage.

The Cochrane Deaerating Heater is admirably adapted to suit heat balance requirements of modern steam plants where the feed water is heated regeneratively by means of bled steam.

It economizes fuel and gives absolute protection to piping, economizers, boilers and turbines against oxygen corrosion.

Engineers everywhere are preferring this type of heater to the ordinary open heater. Besides being more flexible and giving protection against corrosion, it occupies less space, weighs less and is in many other ways more desirable.

COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa. H-14

The "X" Factor In Power Costs

What counts in buying equipment? Not cost per pound, ton or square foot. Not even the cost per unit of actual capacity in kilowatts, thousands of pounds of steam per hour, or whatever it is.

All engineers, when they stop to think of it, admit that the true yardstick in equipment buying is the total cost of rendering a given service. Its elements are interest, depreciation and obsolescence, fuel, labor (including maintenance), supplies, insurance, taxes and "X".

The "X" includes certain important items often overlooked for one reason or another—perhaps because it is impossible to evaluate them exactly in dollars and cents at the time of purchase.

One of these items is shutdown. When the plant shuts down for an hour or even a few minutes the loss may run into thousands of dollars in wasted payroll, spoiled product and damaged morale.

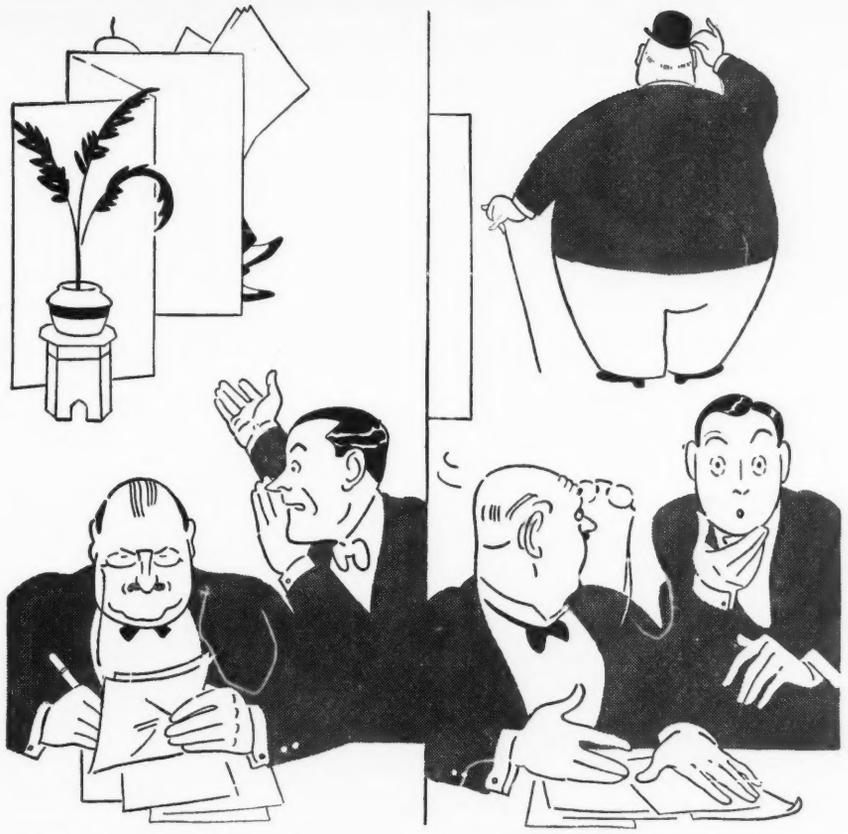
Then there is the item of poor service; pressures and temperatures fluctuate, voltages go up and down, lights flicker and motors change their tune. Rusty water, oily steam and wet compressed air worry the production men and pile up a stack of "seconds" and damaged goods.

In many plants this "X" factor is the most important of all. That's one reason why costly materials and ultra sturdy designs are demanded and paid for in the face of competition by cheaper goods.

The growing importance of this factor today is indicated by the fact that much equipment is designed and sold almost solely to lower "X" in the plant. In this class fall feed-treating equipment, evaporators, deaerators, air and oil filters, moisture separators, regulators and safety devices.

As industry tunes to higher and higher pitches of efficiency, such equipment finds a growing justification—in dollars. It ceases to be a luxury and becomes an essential factor in low production costs.

George Edwards.
Engineer



"He's a six-footer" . . . . "Measured which way?"

Can figures be facts if arrived at wrongly?

In considering performance of heating systems, no analysis or comparison based on hasty acceptance of inaccurate measurements or of incomplete facts, can be safe, or useful unless *all* the factors which may influence the result have been checked. For example, "lbs. per sq. ft. per season" may mean just as little as "twice as long as a piece of string."

There are no less than *forty-five* separate variable factors that may affect the steam consumption of any heating system. To allow any one of them to be overlooked, forgotten or disregarded may lead to faulty conclusion or false decision.

We have prepared a "check-list" of these 45 variable factors to help you check your steam consumption figures and estimates. Write for one or more copies. We will be glad to send them gratis to anybody.

Engineers, architects and heating contractors will find the related subjects of heating steam consumption analysis. estimating and heating cost accounting, as presented by Warren Webster & Company, of vital interest.

A request for further details will bring a Webster steam heating specialist to discuss this vitally important subject.

A Heating System for Every Need and Every Purpose

Heating requirements vary so widely that no one type of heating system can be expected to provide the greatest return on the dollar invested in the heating equipment for all types and sizes of buildings. Realizing this, Warren Webster & Company have consistently developed an entire group of Webster Systems of steam heating to provide *a heating system for every need and every purpose.*

Webster MODERATOR System provides "Controlled - by - the-Weather" heating and makes possible new methods of operation and new standards of economy. Can be applied to any existing steam heating system of sufficient size.

IMPROVED Webster Vacuum System provides distribution balanced from the start—the supply of steam to each radiator is so equalized that all radiators get steam at the same time and in substantially the same proportion, regardless of distance from the boiler. May be supplemented by HYLO Vacuum Variator, permitting manual control by building operator. Applicable to new or existing installations.

IMPROVED Type "R" System for residences and larger buildings as well, combines advantages of steam heating with advantages of hot water, but without limitations. Meets fully the operating requirements of newer fuels, newer types of radiation and newer thermostatic controls. Also provides better-than-ever heating service with old radiation and old controls.

Full details of any or all of these systems will be furnished on request.

Warren Webster & Company, Camden, N.J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 Principal U. S. Cities
Darling Bros., Ltd., Montreal, Canada

-since 1888
Webster
Systems of Steam Heating

a I 56a

This is one of a series of advertisements discussing the factors affecting heating steam consumption. The purpose of the series is to call attention to the methods of heating steam consumption analysis, estimate and heating cost accounting developed by Warren Webster & Company to provide a reliable basis for comparing heating system efficiency. Actual detailed facts and figures of steam consumption of a number of Webster Systems of Steam Heating, prepared in accordance with these methods, are available for your examination.

FOR SEVERE SERVICE

PERMANITE

Trade Mark Registered U. S. Patent Office

THE ORIGINAL HIGHLY COMPRESSED ASBESTOS SHEET PACKING

FERODO AND ASBESTOS, INCORPORATED

Factory and General Offices: New Brunswick, New Jersey

COPPUS DRAFT FANS TURBINES BLOWERS

COPPUS ENGINEERING CORPORATION
350 Park Ave.
Worcester, Mass.
Branches in all Principal Cities

WRITE FOR LITERATURE

Water Tube Boilers for Every Service

BOILERS of high quality for central stations and industrial plants of all sizes, and for utilization of waste heat from kilns and furnaces. Steel construction only. Straight tube and bent tube types. Noted for long life and economy of operation.

Engineering service available—wire or write.

EDGE MOOR IRON COMPANY Edge Moor, Delaware

EDGE MOOR Water Tube BOILERS

STRAIGHT AND BENT TUBE TYPES—WATER WALLS—AIR PREHEATERS

PENNSYLVANIA

AIR COMPRESSORS · GAS COMPRESSORS · VACUUM PUMPS · BOILER FEED PUMPS · CENTRIFUGAL PUMPS · AIR LIFTS · VALVES

PENNSYLVANIA PUMP AND COMPRESSOR CO.
MAIN OFFICE AND WORKS · EASTON, PA.

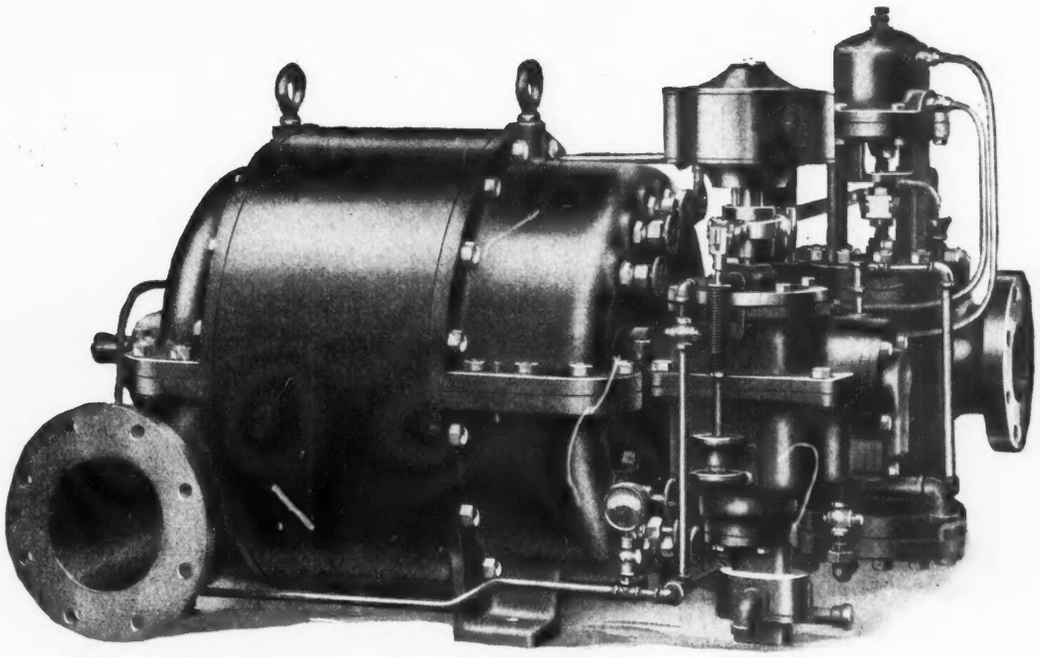
TRI-LOK

OPEN STEEL FLOORING
Triple locked under
1600 tons pressure

Manufactured by
THE TRI-LOK COMPANY
PITTSBURGH PENNSYLVANIA

National Distributors
DRAVO-DOYLE COMPANY
PITTSBURGH PENNSYLVANIA

DRAVO



For main units and auxiliary drives

ESPECIALLY ADAPTED TO

HIGH STEAM PRESSURES AND TEMPERATURES

MOORE
TYPE "S"
MULTI-STAGE TURBINES

The multi-stage type of steam turbine is especially adapted for high pressures and temperatures. Steam consumption is very much less than that of the single stage type as the heat drop between line pressure and exhaust pressure is more efficiently utilized.

With high steam pressures and temperatures the steam velocities in single stage turbines are very high resulting in rapid blade wear. In the multi-stage type of turbine steam velocities are much lower than in the single stage, and as blade wear decreases very rapidly with the decrease of steam velocity, the blade life of multi-stage turbines is much longer.

MOORE

TRADE MARK

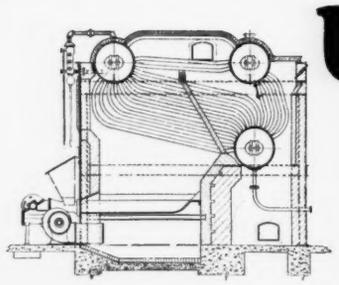
multi-stage turbines are used in leading central stations and industrial plants where high efficiency must be maintained.

Write for Bulletin No. 1921-B

MOORE STEAM TURBINE CORPORATION
WELLSVILLE, NEW YORK

Offices in all principal cities

In Canada: General Supply Co. of Canada Ltd., Ottawa



UNION TYPE BOILERS

CAPACITY EFFICIENCY

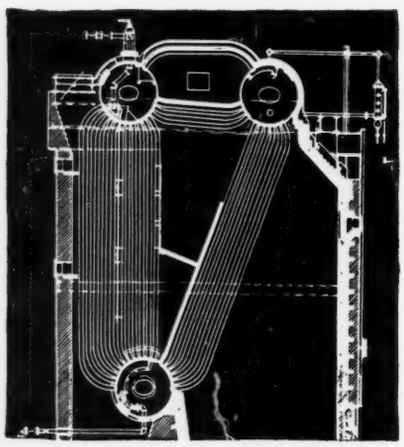
a modification of the standard UNION 3-drum vertical bent tube boiler

FOR RESTRICTED SPACE INSTALLATIONS

—UNRETARDED CIRCULATION—FREE STEAM LIBERATION—DRIER STEAM—NO INACTIVE HEATING SURFACES

UNION IRON WORKS

ERIE, PA



AN EXCEPTIONALLY EFFICIENT THREE DRUM BOILER

Because It Is Equipped With

THE CONNELLY THERMO-WATER STABILIZER

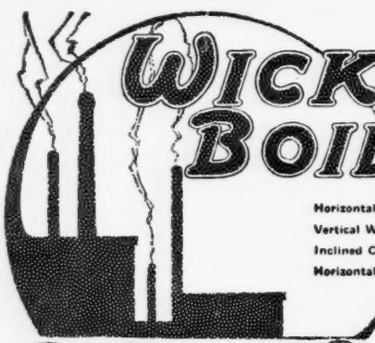
(Patents Pending)

THIS new Connelly design feature gives 100% water-heating surface, insures an exceptionally high efficiency, prevents burning and warping of tubes and makes for many other operating efficiencies. Built in units up to 15,000 square feet of heating surface and for pressures up to 600 lbs.

THE D. CONNELLY BOILER COMPANY

1170 Ivanhoe Road :-: Cleveland, Ohio

BOILER SPECIALISTS FOR 55 YEARS



WICKES BOILERS

Horizontal Cross Drum Boilers

Vertical Water Tube Boilers

Inclined Curved Tube Boilers

Horizontal Tubular Boilers

THE WICKES BOILER CO

SALES OFFICES:

NEW YORK, 501 FIFTH AVE. PITTSBURG, 1218 EMPIRE BLDG. SAGINAW, MICH.

CHICAGO, 33 SO. CLARK ST. DETROIT, 2567 UNION TRUST BLDG.

KINGSFORD

All Steel Sectional Water Tube Boilers

A design and construction that has proved its high efficiency under all steaming conditions. Also builders of horizontal and vertical Unaflow Engines and all types of Centrifugal Pumps. Write for Catalog.

Kingsford Foundry & Machine Works, Oswego, N. Y.

SPRINGFIELD BOILERS

WATER TUBE BOILERS

SECTIONAL

ALL STEEL

Springfield Boiler Co.

Springfield, Ill.

DIAMOND SOOT BLOWERS

Please write for bulletin on boiler cleaning by modern methods.

DIAMOND POWER SPECIALTY CORPORATION-DETROIT

BASEX

WATER SOFTENING ZEOLITE

for Water Softener Construction

by

THE INVERSAND CO., Clayton, New Jersey

VULCAN SOOT CLEANER COMPANY

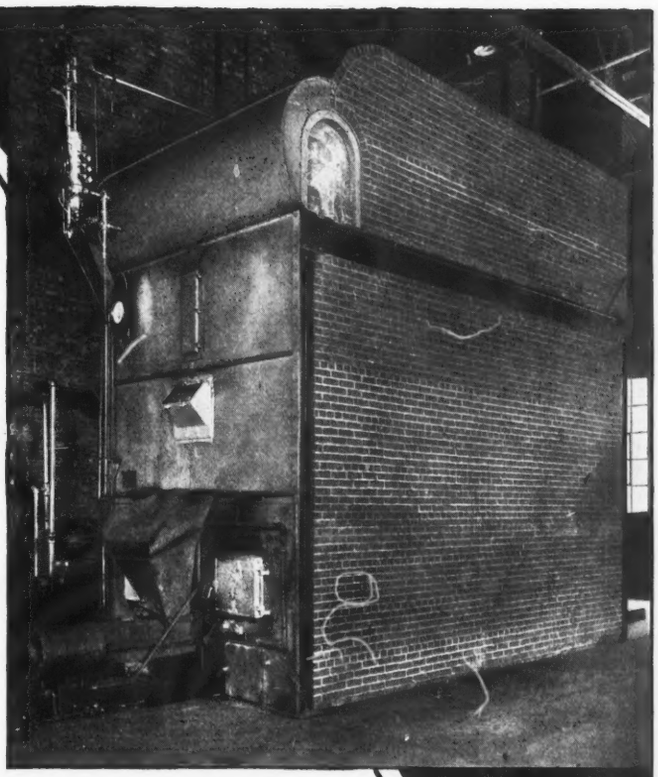
MAIN OFFICE DU-BOIS PA. OFFICES IN THIRTY CITIES

Webster Bldg., DuBois, Penna.

Soot Cleaners For All Types of Water Tube and Return Tubular Boilers. Super-Heaters and Economizers.

For Every Boiler need.

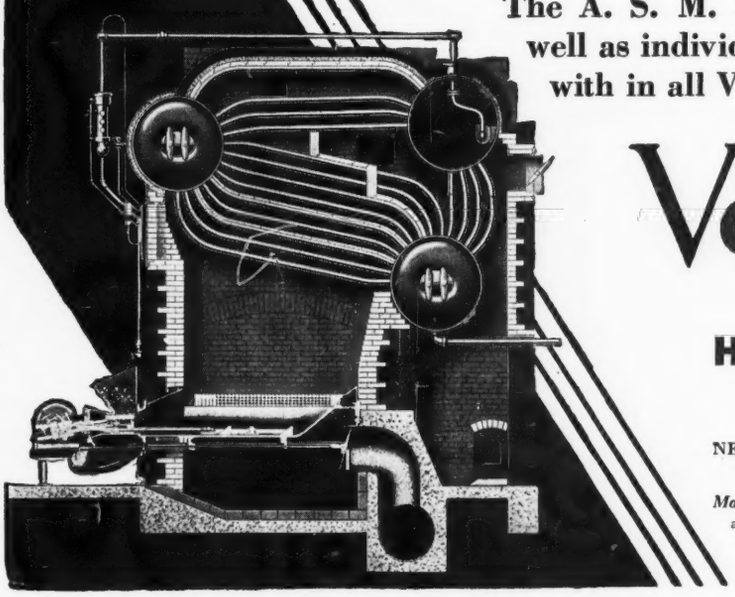
from 80 to 400 Horsepower!



The Vogt Class M Low Type Boiler takes the place of all other designs of small boilers because it combines all the advantages sought for, including increased ratings, higher steam pressures, and adaptability to space limitations. The design is not new—it is merely an adaptation of the Vogt Class L Low Type Boiler which has always been considered good design.

Whether for heating or power, economical operation is assured and any fuel or fuel burning device may be used. The above installation was recently completed for the Brown Wood Preserving Company at Highland Park, Kentucky.

The A. S. M. E. Boiler Construction Code, as well as individual state laws, is strictly complied with in all Vogt boilers.



The Vogt Water Tube *Boiler*

CLASS M LOW TYPE

HENRY VOGT MACHINE CO.

INCORPORATED

LOUISVILLE, KY.

NEW YORK CHICAGO CLEVELAND DALLAS PHILADELPHIA

Manufacturers of: Oil Refinery Equipment, Drop Forged Steel Valves and Fittings, Water Tube and Horizontal Return Tubular Boilers, Ice Making and Refrigerating Machinery, Heat Exchangers.

TYLER

Our complete line enables us to supply boiler tubes for every kind and type of service. A warehouse stock in your vicinity will assure immediate delivery.

Boiler Tubes made of

COP-R-LOY
ARMCO INGOT IRON
O. H. STEEL

Write us today regarding your requirements —standard or special.

THE TYLER TUBE & PIPE CO.
Washington, Pa.

Warehouse Stock

Boiler Tube Co. of America, Pittsburgh, Pa.—Brooklyn, N. Y.; Avery & Saul Co., Boston, Mass.; Beals, McCarthy & Rogers, Inc., Buffalo, N. Y.; John McKenzie & Co., Baltimore, Md.; Tidewater Supply Co., Norfolk, Va.—Columbia, S. C.; Jos. T. Ryerson & Son, Inc., Cincinnati, Ohio; Lukens Steel Co., New Orleans, La.; Young & Vann Supply Co., Birmingham, Ala.; McGowin-Lyons Hardware & Supply Co., Mobile, Ala.; A. M. Castle & Co., Chicago — Seattle — San Francisco — Los Angeles; Harrisburg Pipe & Pipe Bending Co. of Texas, Inc., Houston, Texas.

Special Representatives

W. M. MacCleary, New York, N. Y.; W. H. S. Bateman & Co., Philadelphia, Pa.; Denyven, Linn Co., Boston, Mass.; Peter A. Bauer, Buffalo, N. Y.; J. R. Edwards, Erie, Pa.; J. F. Corlett & Co., Cleveland, Ohio; Harrisburg Supply Co., Tulsa, Okla.

BOILER TUBES

Protect Circulating Systems from Rust

As in heating and cooling water systems, this company has developed treatment for domestic water supply systems. For controlling corrosion in these latter systems, treatment is supplied which will not interfere with the use of the water for any purpose.

From a sanitary standpoint the treatment is entirely proper and will not cause odors or tastes. It can, therefore, be safely used in any water supply system.

The complete research facilities of the Dearborn Laboratories make available the use of the most advanced methods in this field of corrosion prevention.

Consultation invited.

See Dearborn Exhibit, Chicago Power Show—February 10-14.

DEARBORN CHEMICAL COMPANY

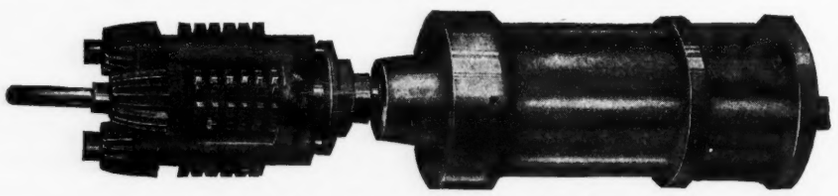
CHICAGO: 310 S. Michigan Avenue
NEW YORK: 205 East 42nd Street

Canadian Offices and Factory: 2454-64 Dundas Street, West, Toronto

Dearborn
TRADE MARK REGISTERED

Four Cleanings a Year May Be Cheaper Than One

The average cleaning time per boiler is reduced by more frequent cleaning and more uniform efficiency of the boiler is maintained.



Roto 4" Heavy Duty Air-Driven Tube Cleaner

Roto Cleaners can also be furnished for various sizes and types of tubes.

THE ROTO COMPANY, Sussex Ave. and Newark St., NEWARK, N. J.

WATER Softening

EST Elgin 1908

Elgin Softener Corporation
ELGIN, ILLINOIS

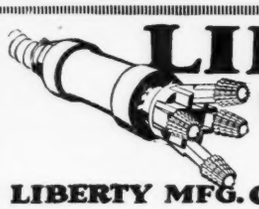
Lagonda Tube Cleaners
Tube Cutters, Reseating Machines
The LAGONDA MANUFACTURING CO., SPRINGFIELD, O.

Nothing So Sure

as the complete riddance of scale from water-tubes or fire-tubes with a Dean Boiler Tube Cleaner.

Dean
REG. U.S. PAT. OFF.

The Wm. B. Pierce Co., Franklin Bldg., Buffalo, N. Y.



LIBERTY CLEANERS

for all sizes and types of tubes

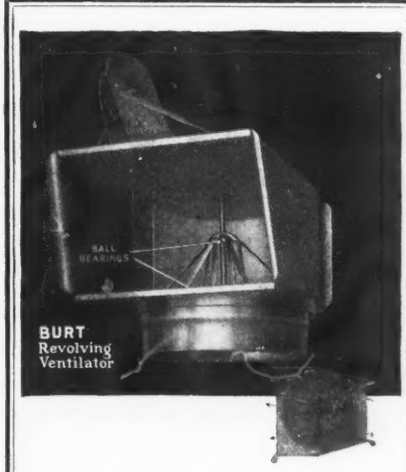
LIBERTY MFG. CO., JEANNETTE, PA.

—a leader in the field of low cost ventilation. Sliding sleeve damper, patented adjustment clip and other exclusive Burt features have made it the most widely known ventilator in the world.

BURTS

will do the Job—

It might be ventilating a boiler room, a steel mill or a fume ridden process industry, but it makes no difference—there's a Burt that will do the job—efficiently and at low cost. If you haven't complete information on the Burt line, write today and ask for details.



—a quiet operating, highly effective ventilator that will give many years of satisfactory service. Every one is factory tested so that it will give you the full benefit of its many advantages.

The BURT MFG. Co.

Ventilators-Oil Filters-Exhaust Heads

232 MAIN ST. AKRON, OHIO

120 HENSZEY DE-CONCENTRATORS

for Automatic Continuous Blow-Down
are now installed in

107 Plants Totaling 367,732 Boiler Horse Power

HENSZEY DE-CONCENTRATOR CO.
Watertown, Wis.

CONDENSER tubes cleaned regularly assure a high vacuum and economy in steam consumption. Use Oakite materials and methods, and you can be certain that all trace of oil, sludge, sediment and deposit is removed from both steam and water sides of tubes in a fraction of the usual time. Ask for our booklet "Oakite in Power Plants." It tells how to do your cleaning jobs quicker, better and more economically.

Manufactured only by
OAKITE PRODUCTS, INC., 40G Thames St.,
NEW YORK

OAKITE
Industrial Cleaning Materials and Methods

BENT TO YOUR SPECIFICATIONS-
BOILER TUBES
STANDARD WIRE & TUBE COMPANY
MINERAL RIDGE (YOUNGSTOWN DISTRICT) OHIO

Water Purification

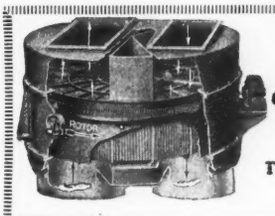
Softeners and Filters
for every industrial and domestic use

Wm. B. Scaife & Sons Co., Oakmont, Pa.
PITTSBURGH NEW YORK CHICAGO

Hercules Seamless Copper Floats Last Indefinitely

Don't buy floats that wear out in a short time and have to be replaced. Hercules Floats because of their remarkable endurance, eliminate constant renewal and repair expense.

Write for prices and details
HERCULES FLOAT WORKS
200 Franklin St., Springfield, Mass.



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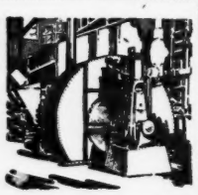

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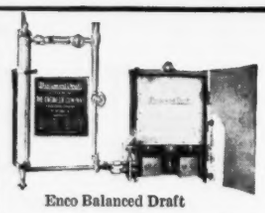

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Enco Baffles for horizontal or vertical water tube boilers in combination with Enco Balanced Draft will greatly improve the operating efficiency and capacity of your boilers.

Enco Burners for oil or gas will lower the cost of steam when burning any of these fuels.

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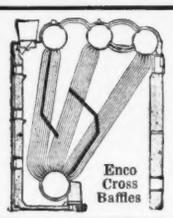
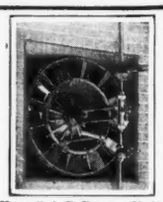


Enco Cross Baffles



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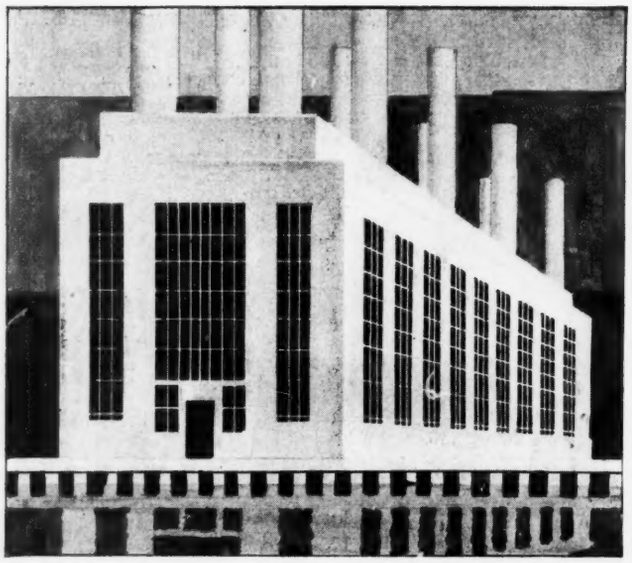

SCOVILL FLUSH TYPE FERRULES

AT the Power Show held in Grand Central Palace, New York, from December 1st to 6th, the Scovill Manufacturing Company released and demonstrated a new method of securing condenser tubes into the tube sheet, by means of a new development, the Scovill Flush Type Ferrule. This ferrule is installed with packing in exactly the same manner as the conventional type ferrule. No special preparation of the tube sheet is necessary and only one special wrench is required.

This ferrule, when installed, is flush with the tube sheet and eliminates the turbulence and release of air, always found when the ferrules project into the water box. The new ferrule does away with the air pocket on the inlet and reduces corrosion on the inlet end, to a minimum.

A representative from any of the Scovill offices will be glad to explain this new method to you, or a letter to the Main Plant at Waterbury will bring you literature, thoroughly describing it.

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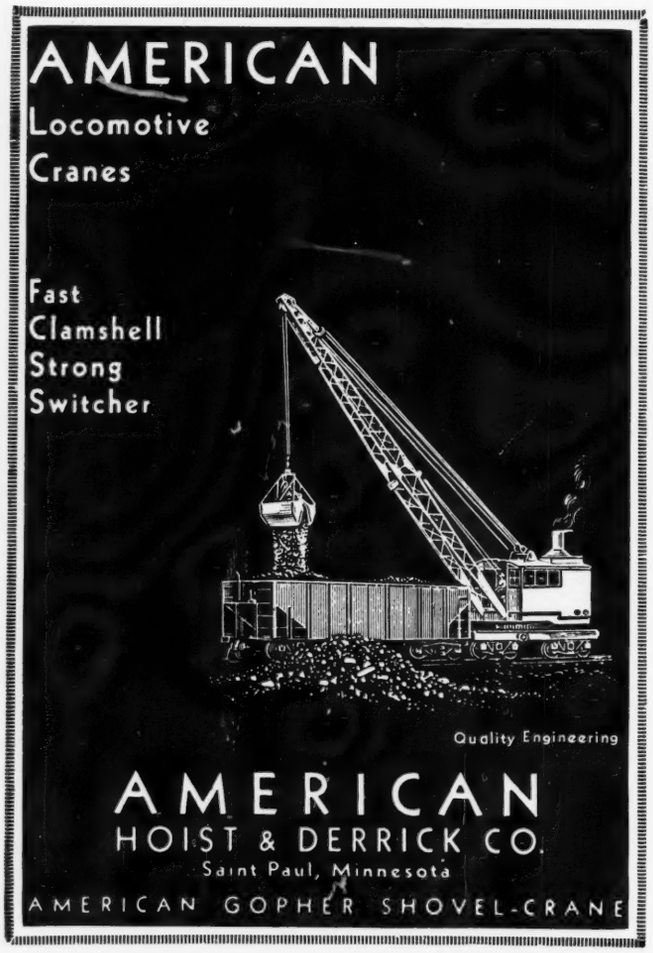

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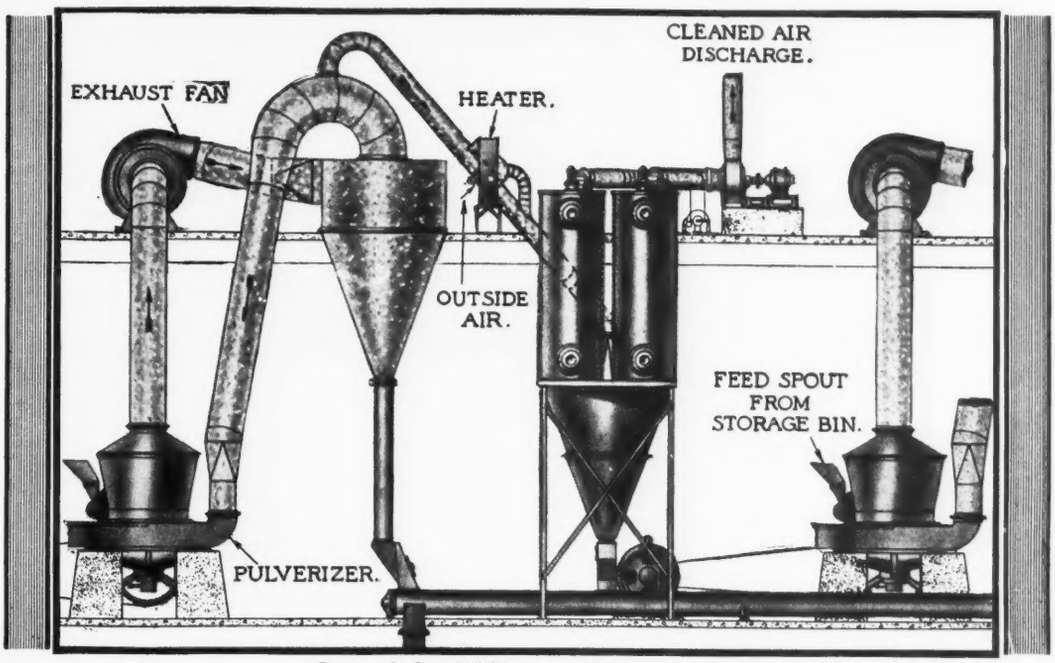
5 THINGS YOU OUGHT TO KNOW ABOUT DRACCO



One of the 26 Dracco Units at Trenton Channel

DRACCO

Dracco Filters are handling Impact Mill Vent discharge in the installation shown to the right. Without disturbing mill balance, this system approaches 100% efficiency in eliminating dust nuisance — discharging clear air and reclaiming wasted fuel.

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IF YOU USE PULVERIZED COAL

DRACCO completely eliminates coal dust nuisance without upsetting air mill balance—

—Recovers as much as 1% of fuel used—delivering it to conveyors ready for use.

—Increases plant efficiency and reduces explosion hazard by providing a dry fuel.

When Applied to Stack Gases

—Eliminates fly ash nuisance—by a system comparatively low in original and operation cost.

—Utilizes waste stack gas heat—for process or drying fuel in pulverizers.

Efficient and economical, each Dracco installation is designed to fit the job for which it is to be used.

Dust or fly ash elimination—whatever your problem—Dracco applies well known principles of dust recovery to effect the results you want.

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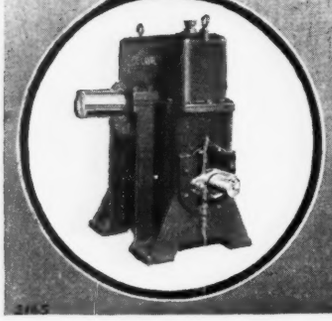
THEY are self-contained and self-lubricated and operate continuously year in and year out, with no attention further than to see that the oil wells are filled. The 35 ratio gears in the photograph are transmitting 3 hp. each from 1200 r.p.m. motors to drive 150 ft. steel flight conveyors carrying empty barrels in an oil refinery.



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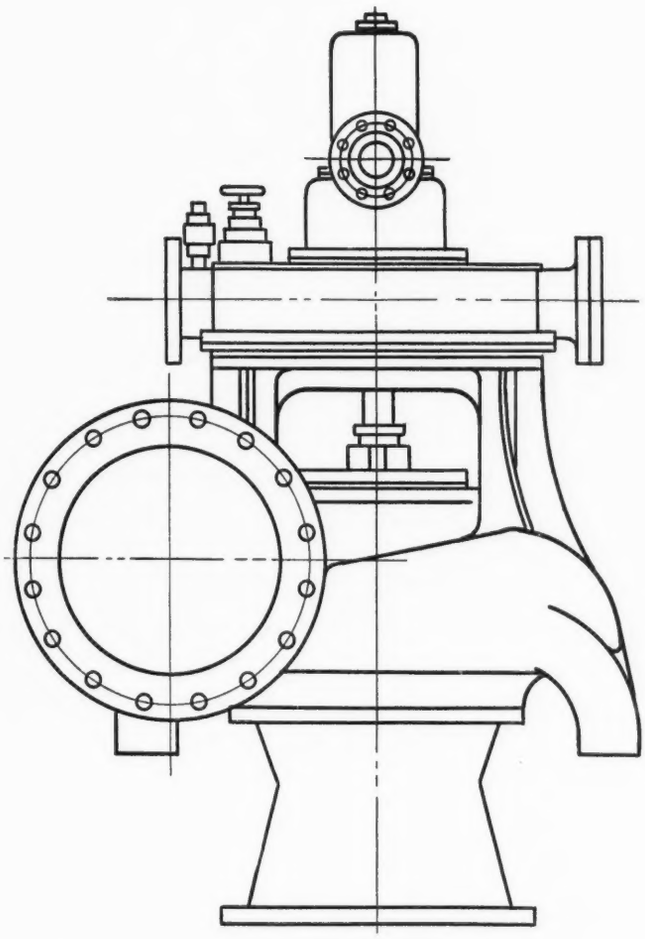

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Warren-Moody pumps are built under the patents of Lewis F. Moody.

The Warren-Moody spiral pump provides three distinct advantages over other types of pumps used for handling large volumes at a low head:

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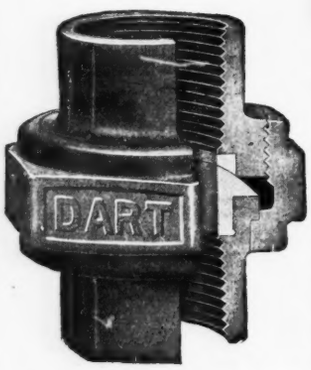

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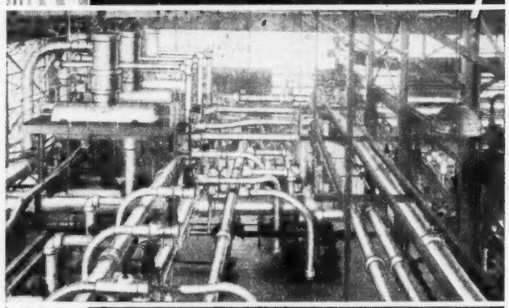

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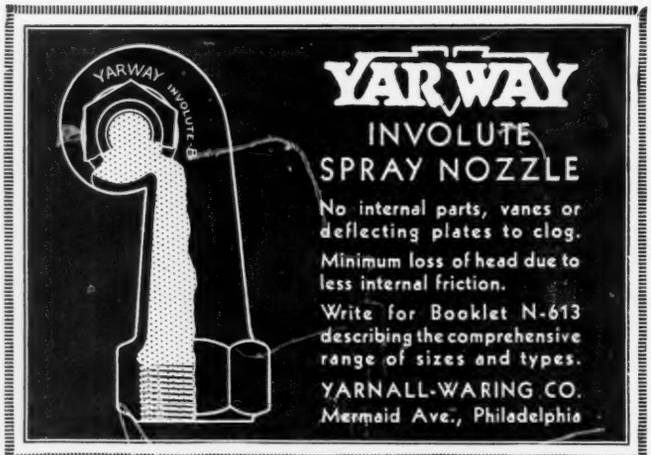

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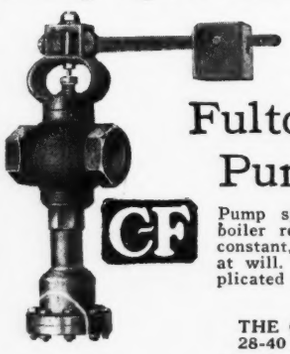

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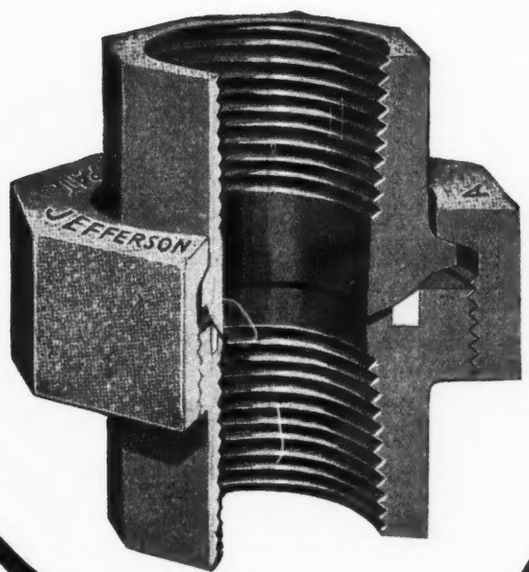

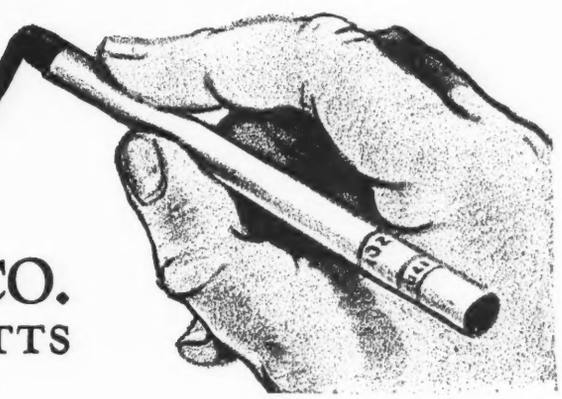

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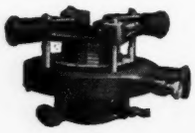

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Cross-Head Guided Type

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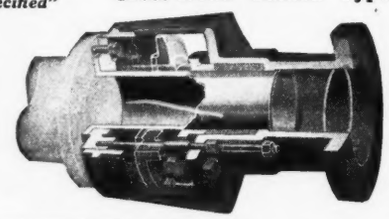

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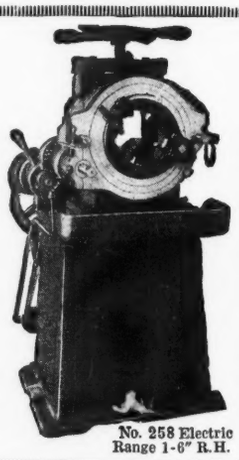

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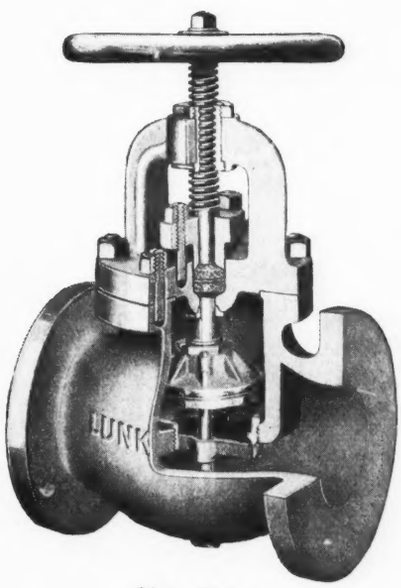
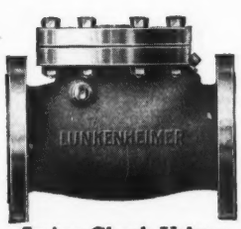
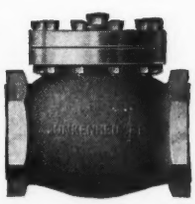


Globe Valves



Swing Check Valves



Horizontal Check Valves

Angle Check Valves

LUNKENHEIMER
IRON BODY BRONZE MOUNTED

Globe, Angle Cross & Check VALVES

have proved in a multitude of installations to be ideal for high steam pressures.

Precision machining throughout, insuring perfect seating of disc; annular seat ring extension in heavy and extra heavy patterns, allowing for expansion and contraction; bronze to bronze contacts which eliminate corrosion; and regrindable and renewable seating surfaces are features which provide uninterrupted economical service.

Globe, angle and cross patterns are made for 125, 175 and 250 lb. W. S. P.—the check for 125 and 250 lb. W. S. P., in all commercial sizes. Also procurable in All-Iron patterns for handling solutions which attack bronze but not iron.

Write for descriptive literature and for the name of the Lunkenheimer distributor nearest you.

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"QUALITY"
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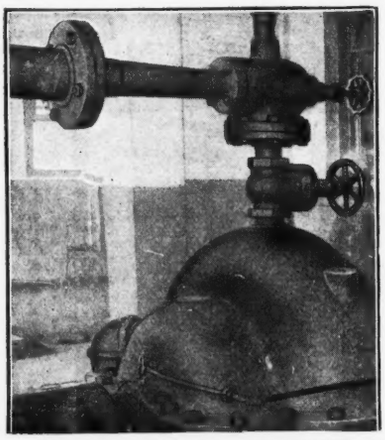
LUNKENHEIMER VALVES

13039-40-42

S & K Pump Primers
have large air handling capacities

Use them on pumps, condensers, syphon systems, etc.

Steam jet type operates with live steam or compressed air.
Water jet type operates with pressure water.

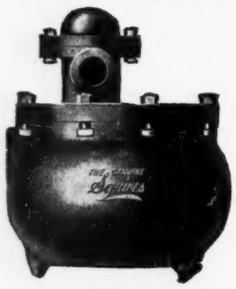


SCHUTTE KÖRTING

Bulletins 4-E (steam) and 4-P (water) contain priming tables and other useful data.

1150 Thompson St., PHILADELPHIA

THE GENUINE *Squires* STEAM TRAP



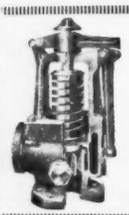
Will eliminate your condensation problems—in steam, air or gasoline.

Catalog A-9 explains

The C. E. Squires Co., Cleveland, O.

DEXTER
Valve Reseating Machines
for Globe Valves—for Gate Valves—for Pump Valves
See the full page ad in the issue of Nov. 25.
Write for Catalog No. 23
THE LEAVITT MACHINE COMPANY
10 East River St., Orange, Mass., U. S. A.

GENUINE NASON STEAM TRAPS
KEEP UPKEEP DOWN
NASON MANUFACTURING CO. 71-FULTON ST. NEW YORK CITY
Steam Specialty Specialists Since 1841



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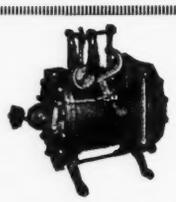
POP VALVES AND GAUGES
Quality Products for Discriminating Users
with a record of over 50 years of dependable service on high-pressure power plant installations.
THE ASHTON VALVE CO.
Boston New York Chicago San Francisco



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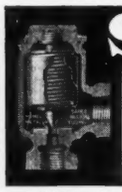
Return Traps - Lifting Traps
Vacuum Traps - Separating Traps
Sterling Engineering & Manufacturing Corp.
(Templeton Mfg. Co.) 119 Business Street, Boston, Mass

LEE Multi-Stage Valves
Patented
Successively expand the pressure drop in stages. Seat tight with every closing. Unsurpassed for heavy duty throttling and blow-off service. Sizes ¾-in. to 3-in. Pressures to 600 lb. *Write for Bulletin 100.*
MULTI VALVE CORP., NEW LONDON, CONN.



SARCO STEAM TRAP
Is self-adjusting at pressures from 0 to 100 lbs. Screws right into pipe line. Only one moving part. Costs about one-third the price of bucket or float traps. *Sold on 30 days' free trial. Booklet A-95 on request.*
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Please Send Catalog
Atlas Valve Co., 289 South St., Newark, N. J.
Please send Catalog No. 21, Edition 2, on "Regulating Devices."
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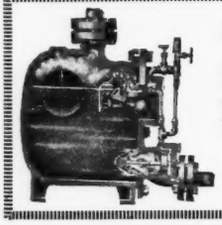

Draining Superheated Steam Lines

Here is a cast steel trap with monel metal trim, welded steel float. Intermittent Discharge, that actually stands up on pressures as high as 450 lbs. and 200° superheat. It's the "Nicholson" Weight Operated Trap.

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KENNEDY VALVES
FOR EVERY POWER PLANT SERVICE

Gate, globe, angle and check valve patterns; in bronze, iron-body bronze-mounted, and all iron; for screwed or flanged connections, and in a wide range of sizes for low, medium, high and extra high pressures. Also complete lines of standard cast iron flanged fittings and flanges, malleable iron screwed pipe fittings and bronze screwed fittings. Send for catalog.

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The Kennedy Valve Mfg. Co., Elmira, N. Y.

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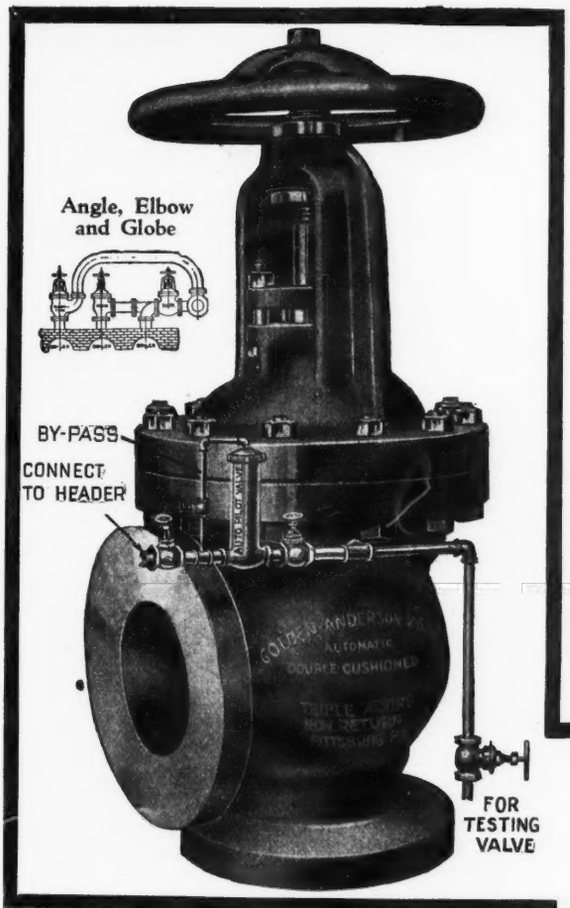
GOLDEN-ANDERSON

Triple Acting Also Non-Return Valves *Withstand High Pressures and High Temperatures*



1. Automatically cut out the boiler the instant that a tube rupture or other internal break occurs.
2. Automatically cut off the steam flow from every boiler the instant that a steam pipe breaks.
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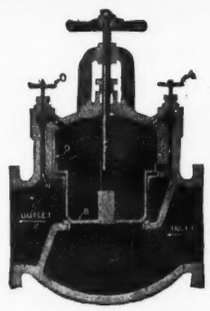
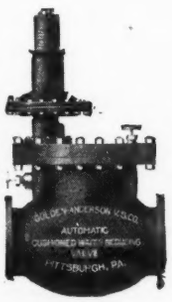
4. Automatically cut in a boiler, making accidents due to inaccurate steam gauge impossible.
5. Positively prevent backflow of steam into a cold boiler.
6. Can be closed by hand, like ordinary stop valve, and arranged with "combination feature" to open valve like regular gate and globe valve.
7. Can be tested in service from boiler room floor.
8. Double Corliss Dash Pot that cushions in opening and closing. As they are sealed and out of current steam flow, dirt and grit cannot bind or stick valves.
9. Cannot pound, spin, stick or chatter.
10. By disconnecting pilot valve, the triple-acting style can be changed into plain non-return.



Pat. Automatic Cushioned Check and Hand Stop Valve

Pat. Automatic Cushioned Steam Pressure Reducing Valves

Pat. Automatic Cushioned Water Float Valves Angle or Globe ½" to 24"



Pat. Automatic Cushioned Water Pressure Regulating Valves

We manufacture a complete line of Steam and Water Service Valves in addition to the ones shown.

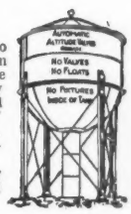
For Water Service

Cushioned Patented Automatic Altitude Valves

For automatically maintaining Uniform Stage of Water in Tank, Reservoir or Standpipes. Doing away with the annoyance of Freezing and Float Fixtures inside or outside of Tanks. "Three Ways of Closing These Valves."

1st—Automatically, by Water.
2nd—By Electricity, if desired.
3rd—By Hand.

May also be arranged to automatically close when a break occurs in the mains. When necessary they may be so connected as to "work both ways" on a single line of pipe. No Valves or Fixtures Inside or Outside.
"Made with stop starter attachment for centrifugal pumps."



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VALVE SPECIALTY COMPANY
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Since we met the Morehead *Engineer . .*

We Save $500 a Year on Fuel

From information received from users all over the country, we *know* that Morehead Back-to-Boiler Systems are saving money every day in every industry where steam is used in process work.

A user in Pennsylvania* says, "We have an accurate check on the fuel our Back-to-Boiler System is saving per annum, which conservatively speaking amounts to more than $500.00. There is also a reduction in the plant's water bill as there are days when no raw boiler feed is used."

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The Morehead Engineer will be glad to tell you, without obligation, how these savings can be made in your plant. Send for him.

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***Rough Dry Laundry Company.**

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Morehead Back-to-Boiler SYSTEM

FACT NO. 3 Handles water of condensation at any temperature—212° and above—the higher the better—without atmospheric vent.

COUPON

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Department P
Detroit, Michigan

I'd like to have your interesting 44-page booklet, giving helpful information regarding the Morehead Back-to-Boiler System. This will, of course, place me under no obligation.

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Company_____

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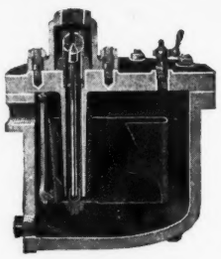

A NEW TRAP
. . . intermittent . . .
instantaneous

This new McDaniel Intermittent Steam Trap is different and better than the regular bucket trap. Instantaneous in action. Discharges at low velocity . . . seats and stems last longer. Baffles prevent steam blowing through discharge. Heavy flanges prevent gasket blow-outs. Many other features. *Send for bulletin.*

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Manufacturers of Steam Saving Appliances
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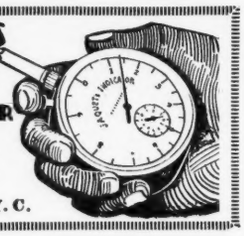
MEASURE SPEEDS with the S&S SPEED INDICATOR

No timing needed — counting mechanism runs 6 seconds. Indicates r.p.m. as well as surface speeds in feet. Write for details.



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SIMPLEX METERS
SIMPLE—ACCURATE—DEPENDABLE
Write for Data
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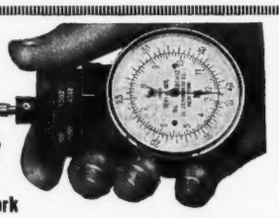
Do away with the troublesome sliding gear shift; ball-bearing, dust-proof, fool-proof, large dial, greatly reduced over all length. Five ranges on one spindle, for speeds from 20-40,000 R.P.M. Dead-beat, accurate within ⅛ of 1%. The only real improvement in tachometer construction in the last 20 years. *Write for new catalog.*



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Southern California Edison Co.
uses
"John Crane" Metallic Condenser Packing

Bell Inflow Ends—Pack Outflow Ends

NO FERRULES

¶ The Southern California Edison Company is one of the many companies which enjoy the advantages offered by the "John Crane" New Method of packing surface condensers. The inlet end of the tube is belled into tube sheet. The outlet end is packed flush with the tube sheet with "John Crane" endless metallic rings separated with small expansion rings. Packing is calked with light hammer blows. ¶ **The results:** Ferrules are eliminated; material and labor costs are reduced; hydraulic performance is increased; greater packing depths are permitted; frequent re-packings are eliminated. Tubes expand and contract at outlet end without undue stresses. Tube deformation is eliminated. Tube cleaning is simplified and clogging of inlet ends reduced. Metallic bonding tends to reduce electrolytic disintegration of tube ends. ¶ Our Service Engineers will inspect your condenser jobs and assist in cutting down installation costs. We carry a complete line of condenser tools for this work. Estimates and recommendations furnished gladly.

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Can you use it?

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IF YOU are qualified for position between $2,500 and $25,000 and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established twenty-one years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 270 Main Street, Buffalo, New York.

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CHIEF operating engineer, age 37. Education, high school and university. Broad experience in the operation of steam central stations up to 100,000 kw. desires position as assistant to superintendent or chief engineer. PW-9, Power, Tenth Ave. at 36th St., New York.

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Hp.	Volts	Make	Speed
500	2200	G.E.	900
350	2200–440–220	G.E.	720
220	220–440	G.E.	450
200	2200–440–220	G.E.	600
150	220–440	G.E.	720
150	220–440	Westghse.	1200
150	220–440–550	G.E.	600
100	2200	Westghse.	900
100	550	G.E.	720
100	440–220	Allis-Chal.	900
100	440–220	G.E.	720
100	440–220	G.E.	900

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

1—165-kw., 125-250-v., 6-ph., 60-cy., 1200-r.p.m. G.E., with 2300-4000-v., 3-ph., transformer
1—125-kw., 125-v., 1200-r.p.m., G.E., MPC, connected to AT1, 440-220-v., 3-ph., 60-cy., syn. motor.
1—100-kw., 250-v., 3-ph., 60-cy., 1200-r.p.m., Westinghouse, with 2300-v. transformer.
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1—250-kva., 200-r.p.m., 2200-440-v., G.E.
1—187-kva., 720-r.p.m., 2200-440-220-v., G.E.
1—120-kva., 900-r.p.m., 2300-4000-v., G.E.
1—112 ½-kva., 900-r.p.m., 2200-240-480-v., G.E.
1—75-kva., 1200-r.p.m., 2200-480-240-v., G.E.
1—62 ½-kva., 1200-r.p.m., 240-480 v., Westinghouse.
1—56-kva., 1200-r.p.m., 240-480-v., G.E.
1—50-kva., 1200-r.p.m., 2300-480-240-v., G.E.

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1050 cu.ft. Worthington 18-in. and 11x14-in. Duplex.
500 cu.ft. Ingersoll-Rand, Class XRB, 13-in. and 8x12-in. Duplex.
Both complete with idlers, unloaders and intercoolers.

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Nordberg-Carels Diesel Engine, No. 30173, Type 3VE, 330 b.hp., speed 225, 3 cylinder.
General Electric A.C. Generator, No. 2540617, Type AT1, amps. 675, speed 225, P.F.-8, kw. 225, 60 cycles, 281 kva., 240 volts.

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Specialists in Motors, Generator Sets, Synchronous Motors, Transformers.

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24—Busch-Sulzer 6 cylinder, 4 cycle, 14¼-in.x 14½-in., 327 r.p.m. complete auxiliary equipment.
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Our summary contains a complete list of equipment under above classification

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BRAND NEW

Westinghouse Motor Generator Sets

Extremely Low Price

1½ kw., Westinghouse, type C.D., 125 v., D.C., mounted on steel base by flexible coupling to 3 phase 60 cy. 220/440 v. motor. Some sets with single phase motors.

Large stock of Motors, Generators, etc.

L. J. LAND
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Owing to the Holiday New Year's Day, Jan. 1st, the "*Searchlight*" pages of Jan. 6th issue of

POWER

will close one day in advance of the regular schedule.

Advertisers' co-operation in sending new advertisements or changes of copy early will be appreciated.

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Display Ads
5 P.M. Tuesday, Dec. 30th.

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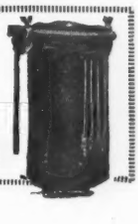

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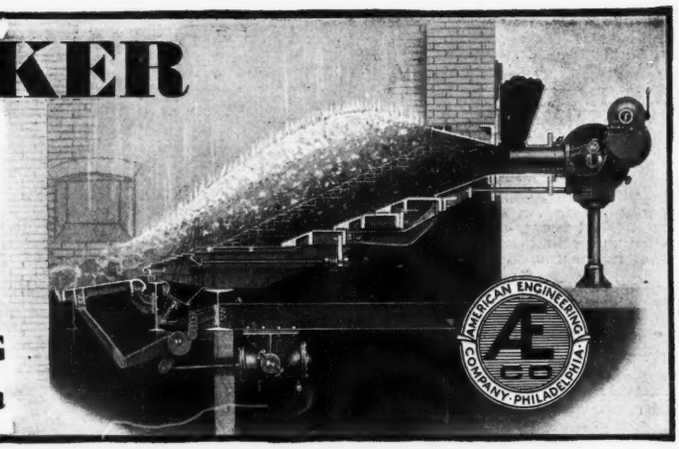

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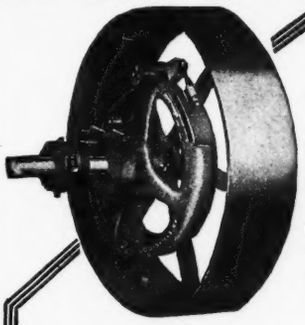

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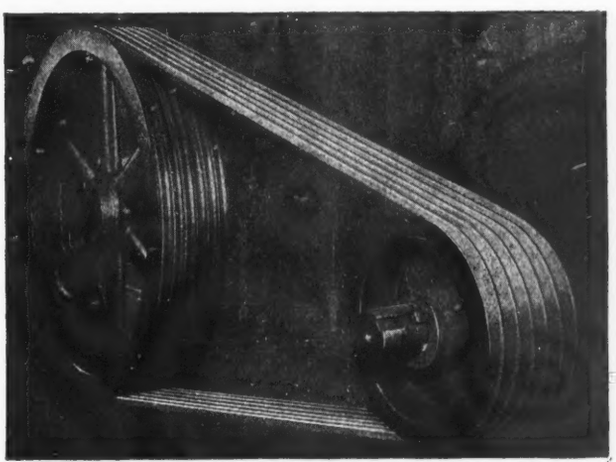

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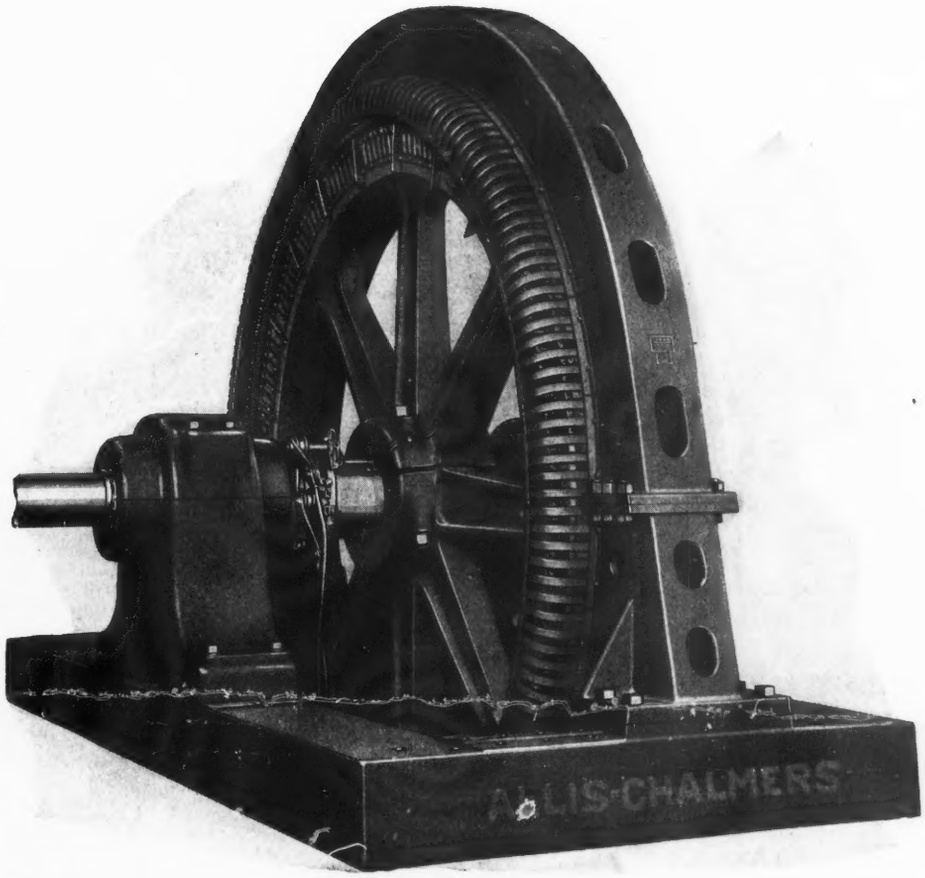

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Nash Engineering Co.
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Terry Steam Turbine Co.
Warren Steam Pump Co.

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Playford Stoker Co.
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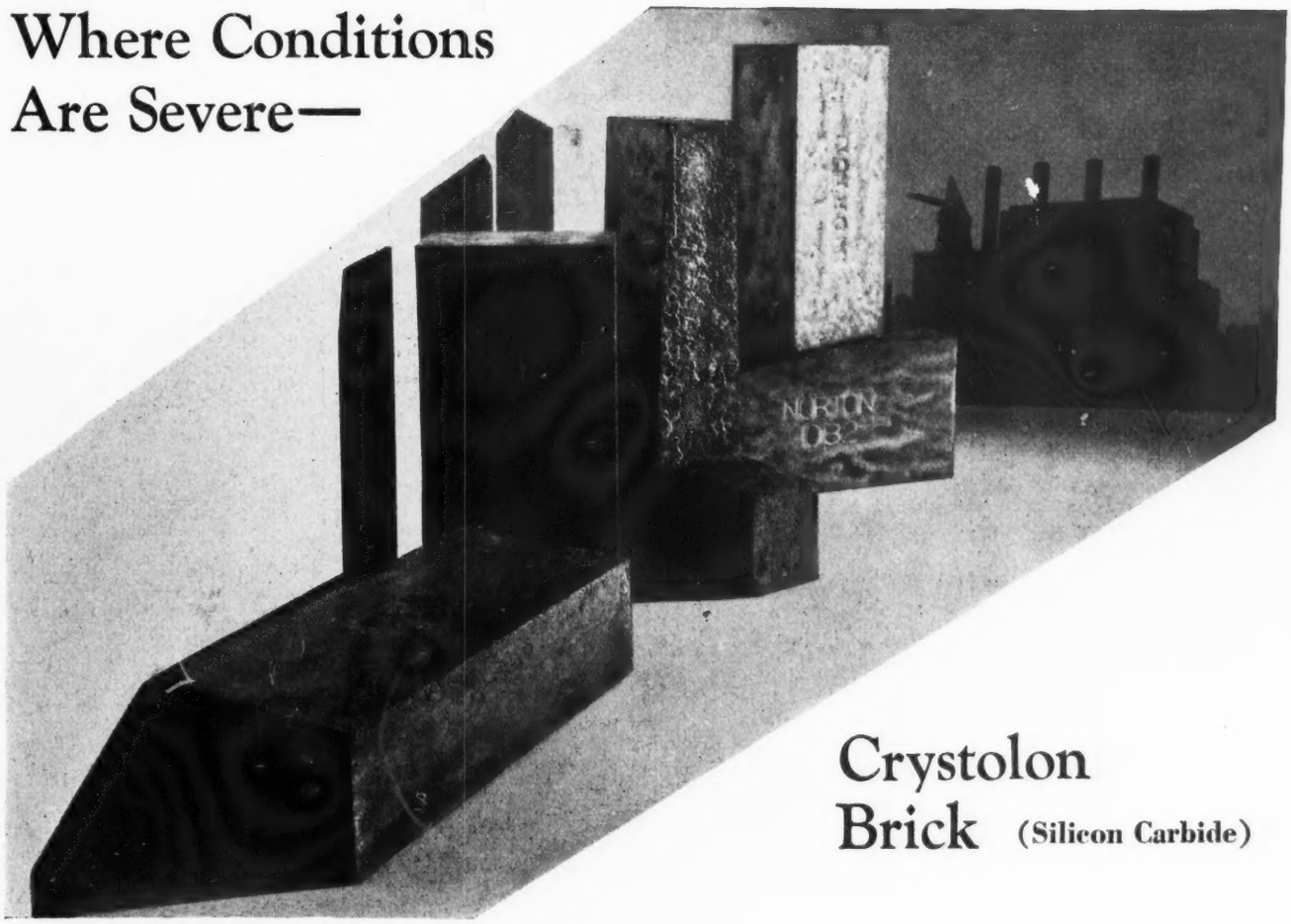

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